Electrical Contracting

VICTORY LOAN

THE MAGAZINE OF ELECTRICAL CONSTRUCTION & MAINTENANCE



NOVEMBER · 1945

No. 1 HELPFUL HINTS ON APPLYING CAPACITORS

To help you improve power factor, reduce kva demand, increase circuit loadability and, often, reduce power costs

A WORKABLE DEFINITION OF THE TERM "POWER FACTOR"

The term arose because, in alternating-current circuits, the energy supplied to induction motors, transformers, and other inductive equipment is composed of *two* kinds of current:

1. Power-producing (or "working") current, which is converted by the equipment into useful work.
2. Reactive current (also called "magnetizing," "nonworking," or "wattless"), which is needed to magnetize inductive equipment before it will operate and while it is operating.

This current is *not* converted by the equipment into useful work. For example, it provides the flux across the air gap of an induction motor, through which the kilowatts flow to do work connected to the shaft. The *vector sum* (explained at the right) of these two currents is termed the "total current"—the actual current supplied to the load.

"Power factor" simply expresses the ratio of power, or "working," current to the total current.

The "working" current is usually expressed in watts or kilowatts, the total current in volt-amperes (volts × amperes) or kilovolt-amperes $\frac{(\text{volts} \times \text{amperes})}{1000}$, or in a 3-phase system $\frac{(\sqrt{3} \times \text{volts} \times \text{amp}).}{1000}$

Hence, in a formula: Power factor $= \frac{\text{kw}}{\text{kva}}$

Example:

What is the power factor of the load on a 460-volt, 3-phase system if an ammeter shows 100 amperes in the circuit and a wattmeter reads: 63.6 kilowatts?

Since, in a 3-phase circuit:

$$\text{Kva} = \frac{\sqrt{3} \times \text{volts} \times \text{amperes}}{1000}$$

$$= \frac{1.73 \times 460 \times 100}{1000} = 79.6$$

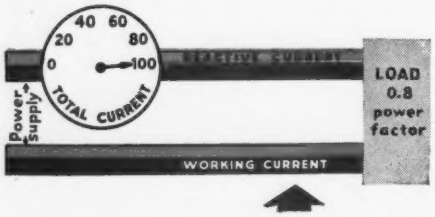
$$\text{Power factor} = \frac{\text{kw}}{\text{kva}} = \frac{63.6}{79.6} = 0.8 \text{ or, as often expressed, } 80\%.$$

WHAT "POWER-FACTOR IMPROVEMENT" REALLY IS

To "improve power factor" you simply neutralize or eliminate the reactive current from the feeder by supplying it locally. When this current is completely neutralized, all the current is "working." When the "working" current and total current are equal, the power factor is "unity," or, as sometimes expressed, 100%.

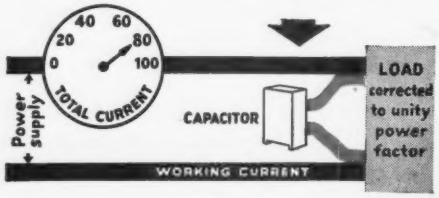
Capacitors are usually the easiest, quickest, and least expensive method of supplying reactive current. They are "generators" of the reactive current required by inductive loads. When they are located near the load, they furnish the magnetizing requirement direct, and the power circuit need furnish only the "working" current.

Using the case at left as an example:



The load draws 100 amperes from the supply circuit. Because part of the current is consumed by the magnetizing requirements (orange line) of the load, only 80 amperes are actually being converted into useful work.

After a capacitor is added, the magnetizing requirement is supplied by the capacitor, and it is necessary for the supply circuit to deliver only 80 amperes to get exactly the same work. *No feeder capacity is wasted in nonproductive work.*

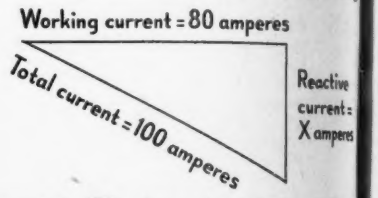


Similarly, if four such loads were fed from the same circuit, the supply current would be sufficiently reduced, by means of the capacitor, to make it possible to add another load of the same magnitude without increasing the current.

WHERE 100 − 80 = 60

In the first sketch shown above, it would appear that since the current supplied to the load is 100 amperes, and since only 80 amperes of this are being converted to useful work, the magnetizing requirement of the load must be the difference between the two, or 20 amperes. Hence, it might further be assumed that a 20-ampere capacitor should be installed to compensate for the magnetizing requirement. However, neither of these assumptions is correct. The subtraction of the "working" current from the total current never equals the magnetizing requirement—an important fact to remember. The relationship of the "working" current to the total current is known as a "vectorial" relationship. Although difficult to explain in a few words why this is so, the relationship itself is easy to show with a right triangle.

This right triangle makes it easy to find the correct value of the magnetizing



current (X), by using the well-known formula for a right triangle, viz., the square of the longest side is equal to the sum of the squares of the other two sides. Therefore,

$$(80)^2 + (X)^2 = 100^2$$
$$(X)^2 = 10{,}000 - 6400 = 3600$$
$$X = 60$$

Therefore, a capacitor that will deliver 60 amperes must be installed to supply the full magnetizing requirement of the load, rather than a 20-ampere unit, as might at first be supposed.

Capacitor *application* data can be obtained by writing for Bulletin GEA-3225A. Bulletin GEA-2742C will bring you *product* data on Pyranol capacitors for power-factor improvement. *General Electric Company, Schenectady 5, N. Y.*

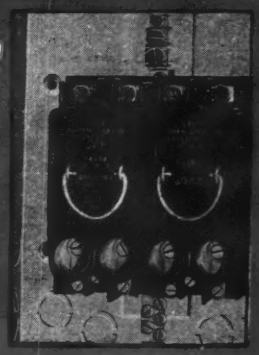


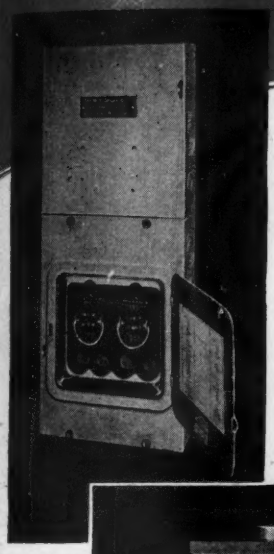
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GENERAL ELECTRIC

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"What switch," say you? These "PULL-OUTS", say contractors!





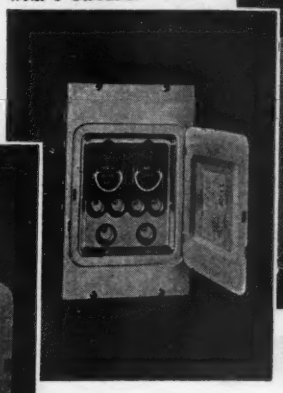
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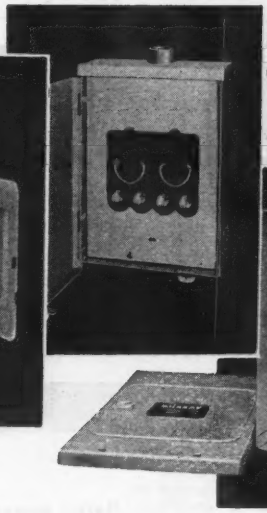
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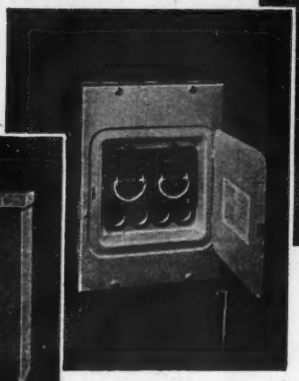
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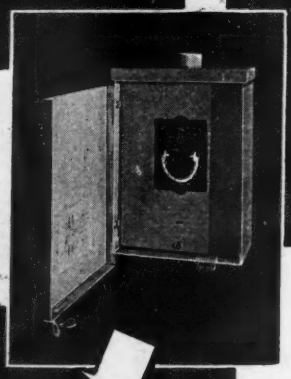
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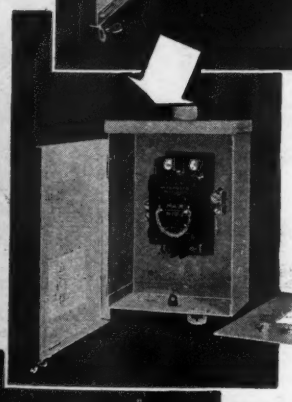






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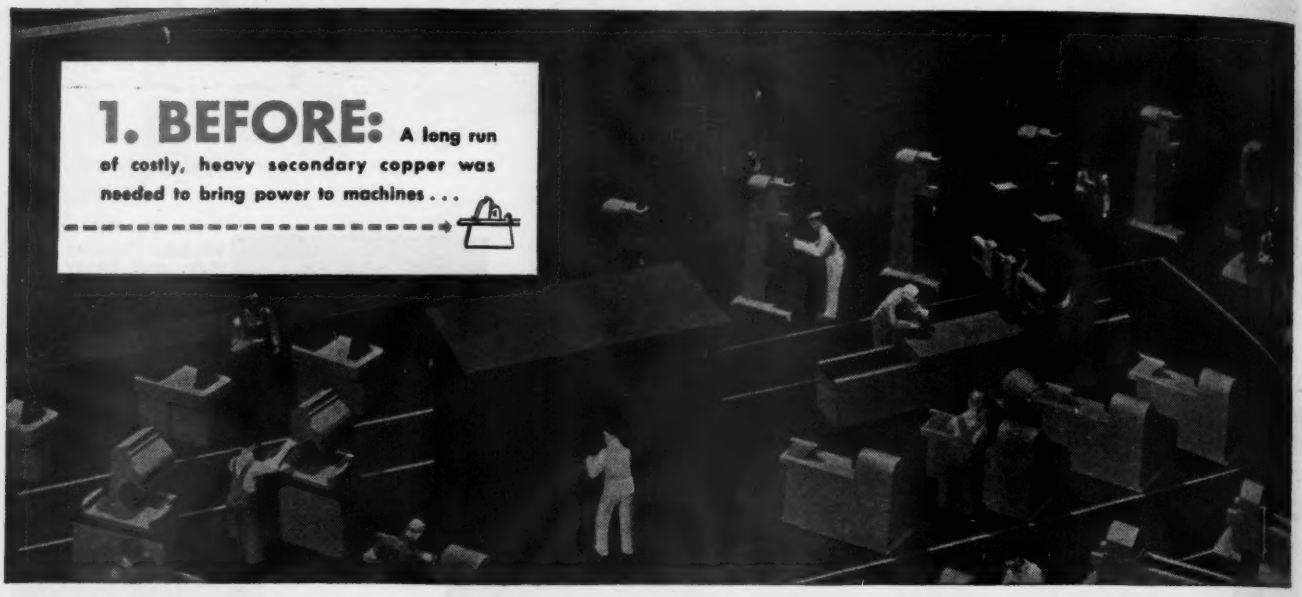
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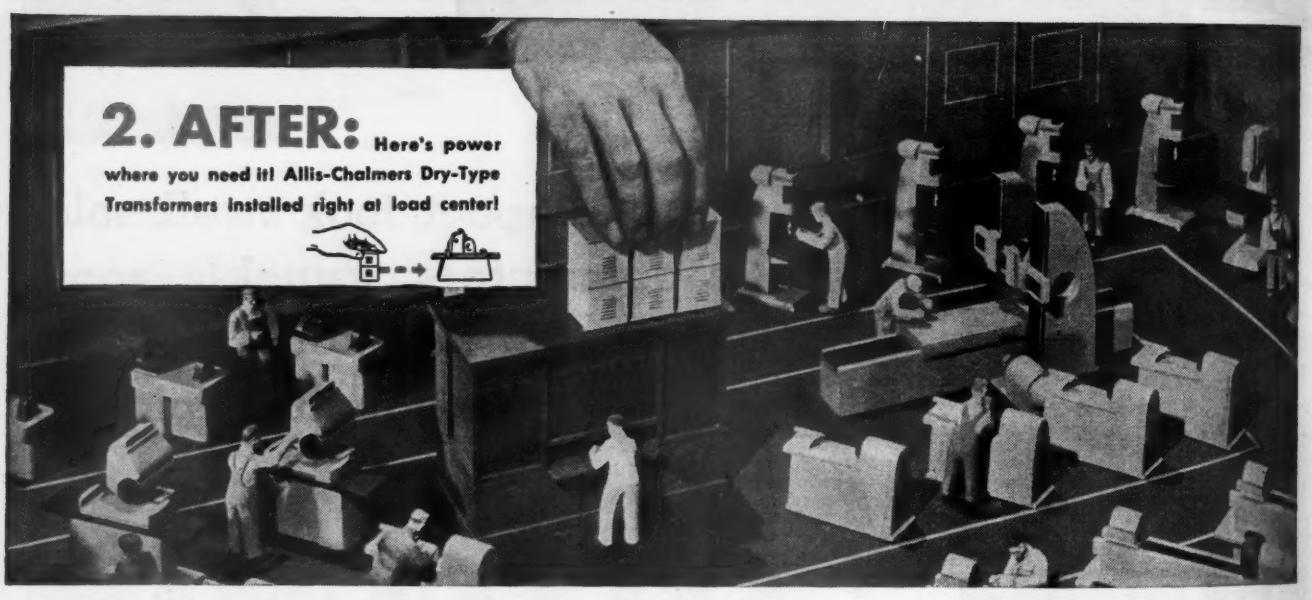
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TO STEP-UP MOTOR AND LAMP PERFORMANCE!





CONTRAST THESE TWO PICTURES. No. 1 shows a condition of *poor* lighting and motor performance. This is a result of line losses and low voltage incurred over a long run of heavy secondary copper bringing power to the machinery being served.

Now look at picture No. 2. By installing 3 Allis-Chalmers AD Dry-Type Transformers *right at load center*, motor and lighting performance have been *stepped up!* That power consuming run of secondary copper is *eliminated*. Man-hours and materials were *saved* . . . no insulating liquid or fireproof vaults were needed.

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Electrical Contracting

With which is consolidated The Electrician and Electrical Record . . . Established 1901

Contents for November, 1945

November—*at a glance* 43

Markets for Space Heat—*An Editorial* 47

These Estimators Share Experience .. 47
Chicago electrical contractors have contributed much to sound estimating methods and accurate costing through systematic study and sharing of experience data.

How to Check Fluorescent Components 49
By HARRIS REINHARDT—Practical circuits for checking fluorescent lamps, starters and ballasts, with ideas to use in designing test boards and kits to meet particular needs.

How Much Will It Cost—Part II..... 52
By RAY ASHLEY—Units for Services, Conduit and Wire circuits are presented in this article.

Simplified Supports 56
By AUGUST ECKEL—How a new structural framing member "Unistrut" solves numerous mounting problems in the electrical construction field.

Silicone Insulation for Maintenance.. 58
By WALTER RUPPRECHT—How an electrical maintenance department uses silicone insulations.

Show Window Lighting Techniques.. 60
By BERLON C. COOPER—A discussion of requisites for good window lighting, including suitable types of lamp sources, reflectors and accessories.

What Voltage for Industrial Plants .. 64
By D. L. BEEMAN—Wiring and equipment costs, which include motors, control, switchgear and transformers are compared for two distribution voltages.

Electrical Equipment for Hazardous Locations 66
By J. A. TROVILLO—A look into the research, design and testing technique that backs up the U.L. Label for approval.

Industrial Electrification 157
The Control of Stray Currents

Departments

Practical Methods 70
Data Sheet 77
Electronics 127
Motor Shops 139
Modern Lighting 147
Reader's Quiz 170
Questions on the Code.....181
Equipment News 189
In the News.....199
Manufacturers News 232
Advertisers' Index 242

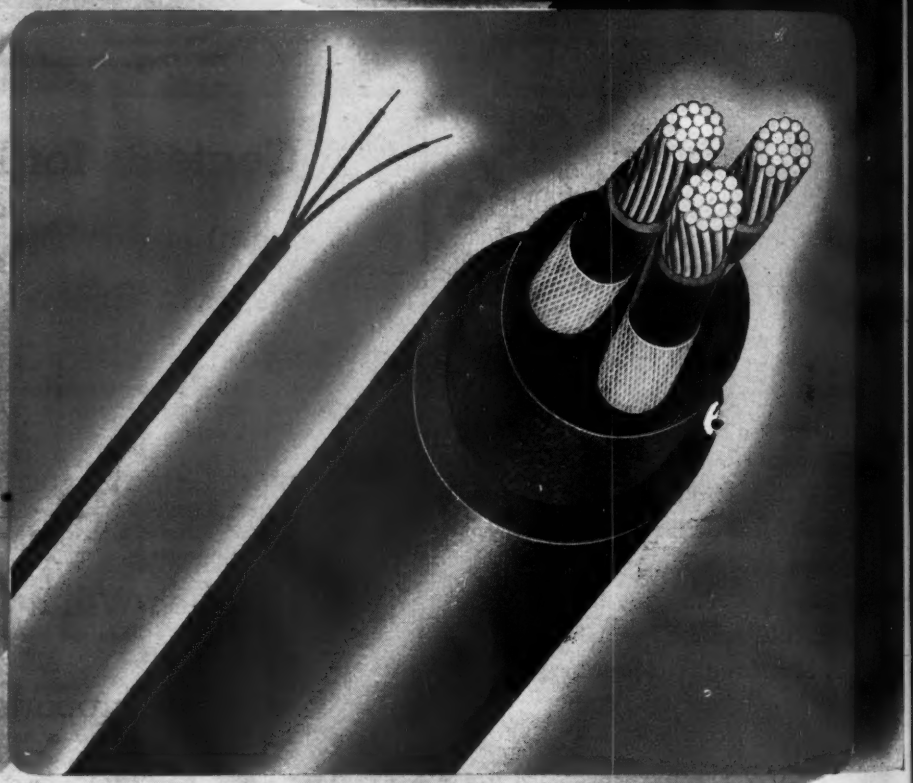
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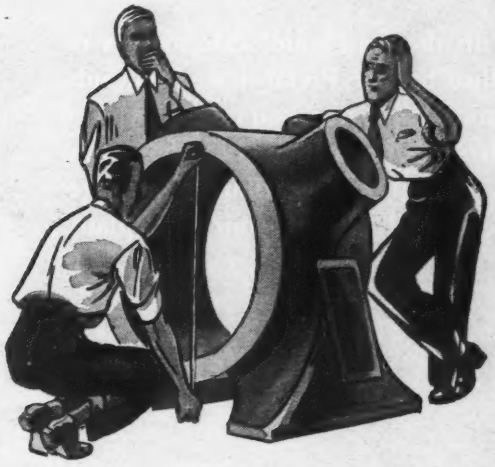
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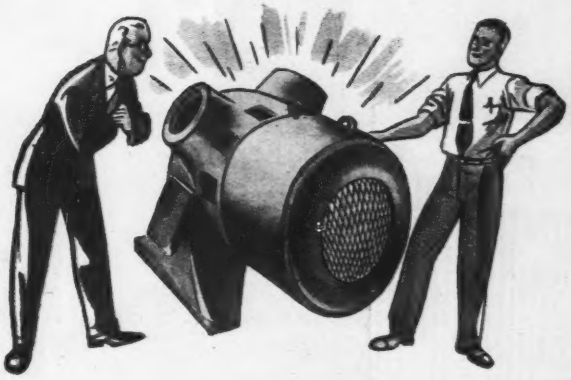




"I Don't Want This! Looks like the motors in San Francisco and the compressor's in New York. What I want is a motor that'll hug that compressor so close you can't tell where one starts and the other ends. It's got to . . ."

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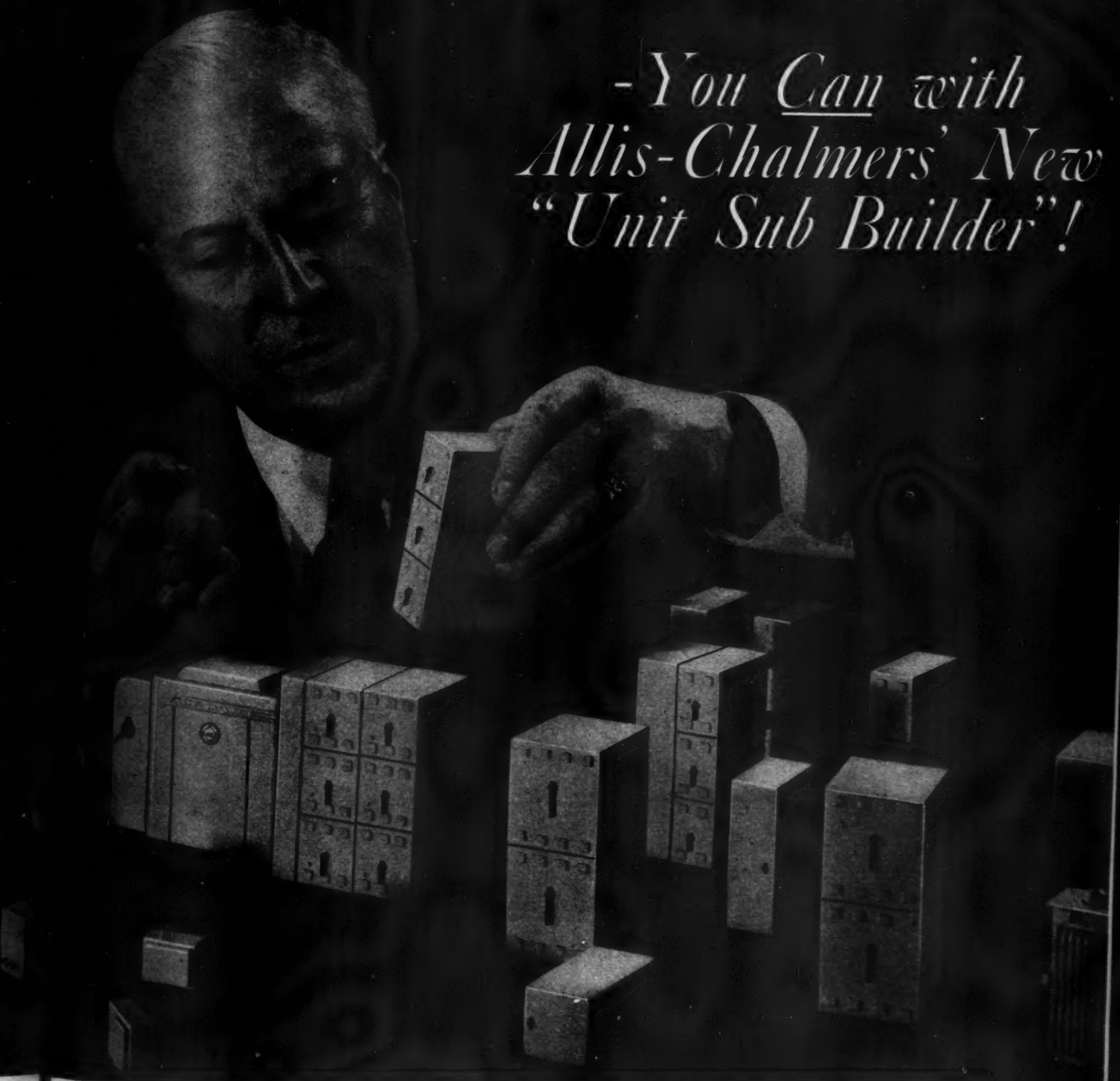
And it's good insurance — you *pre-test* your ideas — *see* just what you're getting in terms of dimensions, characteristics, appearance.

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r Unit Sub Ideas

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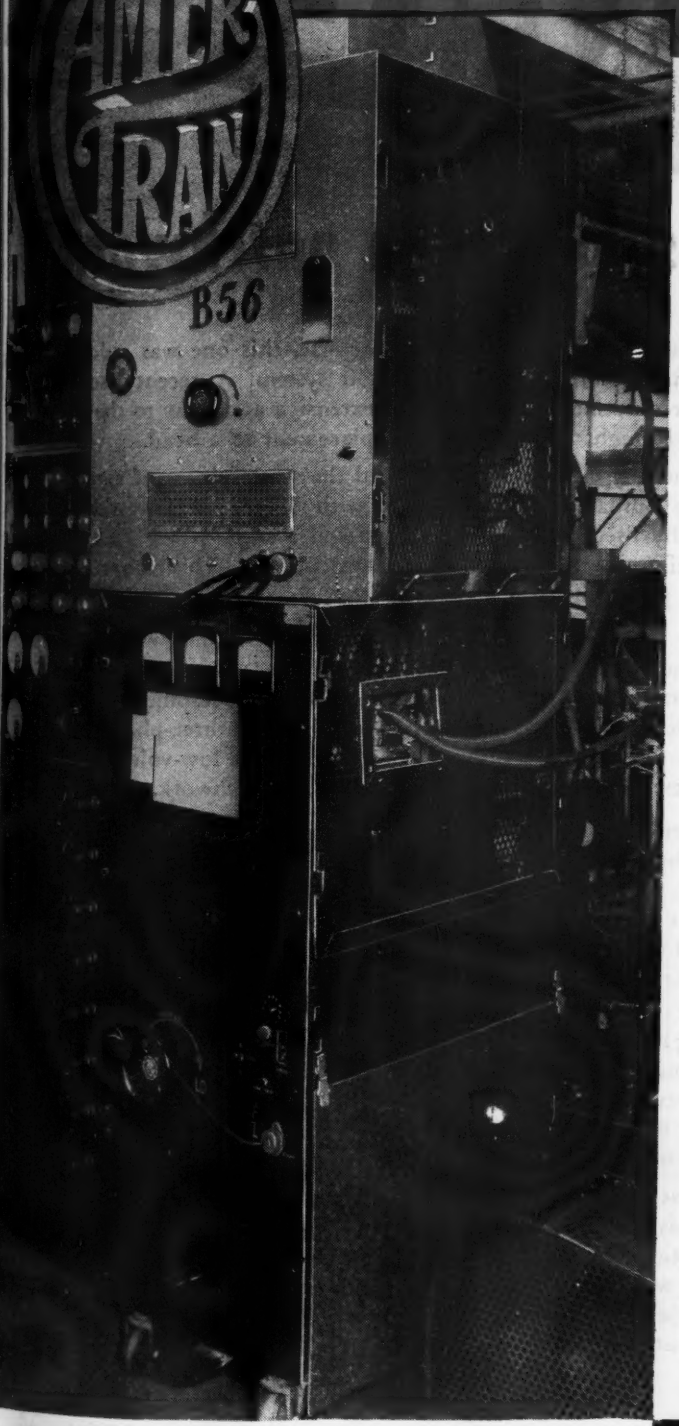
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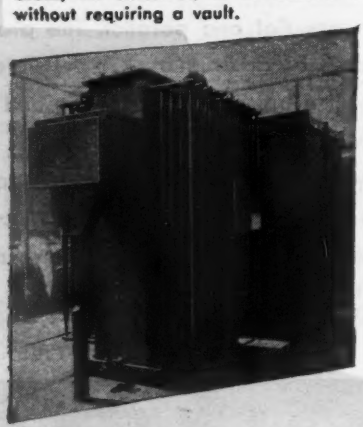
RE-POWERED

at less cost than *patchwork!*

Load-center distribution system supplanting old-time system step-by-step will pay the full costs of replacement



Unit substations are easy to install; the use of Pyranol* or dry-type transformer sections, with safety metal-enclosed switchgear, permits them to be located on the factory floor adjacent to the load areas, on balconies, or in basements without requiring a vault.



Where building layout makes it desirable, unit substations are built for installation outdoors.

*Pyranol is the G-E trade mark (Reg. U. S. Pat. Off.) for askarel, a noninflammable, nonsludging insulating liquid.

Like many older plants of moderate size, this one was saddled with an obsolete power distribution system. A recent rise in power requirements, necessitating extensive additions to the old system, brought the problem of replacement to a head.

A study by G-E engineers showed the wastefulness of extending the outdated 2-phase system with 5-wire feeders such as originally used. Instead, they suggested a *step-by-step plan* for converting to load-center power distribution. This conversion plan is paying its own way right from the start.

1. The immediate need for extra power is being met with a new G-E load-center unit substation. The customer saved 5 per cent on first cost alone by buying standard three-phase equipment for the expanded main service. The total cost of *all* the three-phase high-voltage feeders was less than the cost of just the low-voltage two-phase extension, had the need been met by patchwork.

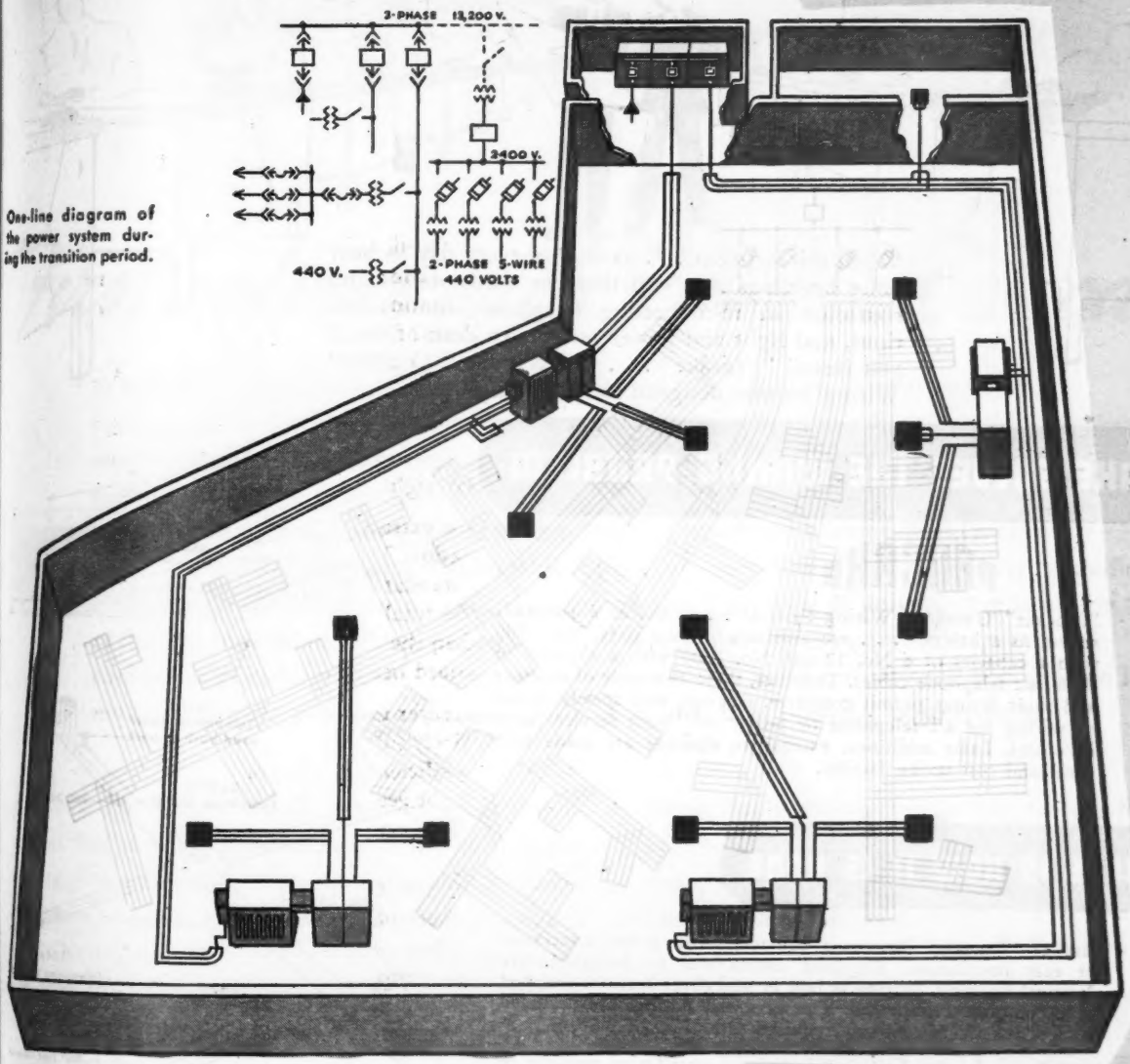
2. Later, additional load-center unit substations will be installed, until the old system is entirely supplanted. Savings resulting from the 2½ to 5 per cent extra efficiency of the three-phase system will amount to $2000 to $4000 per year in power costs alone. This will pay off the costs of complete modernization at some 20 per cent per year.

The changeover is being made without production shutdowns during installation of the three-phase system, or in the changeover from the obsolete system. The new system will be safer, and require less servicing time. When completed, the customer will have a power distribution system *engineered for growth,* whatever the extent of the plant's future power needs.

What does a check-up of your own power distribution system show as to voltage conditions, outages, maintenance costs, and restrictions on plant expansion? Perhaps modernization the load-center way can be planned so as to be fully self-liquidating. Ask your local G-E representative, or write for Bulletin GEA-3758. *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

KEEP ON BUYING BONDS — AND KEEP ALL YOU BUY

FOR GROWTH



One-line diagram of the power system during the transition period.

New feeders (black) will replace the old feeders (yellow) and establish a simplified, modern distribution system.

GENERAL ELECTRIC

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LOAD-CENTER POWER DISTRIBUTION SYSTEMS

"We'll have to move this department to the floor above"

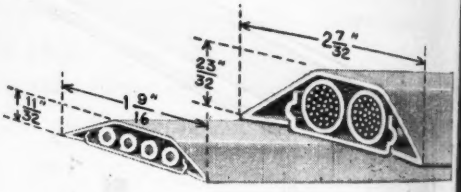


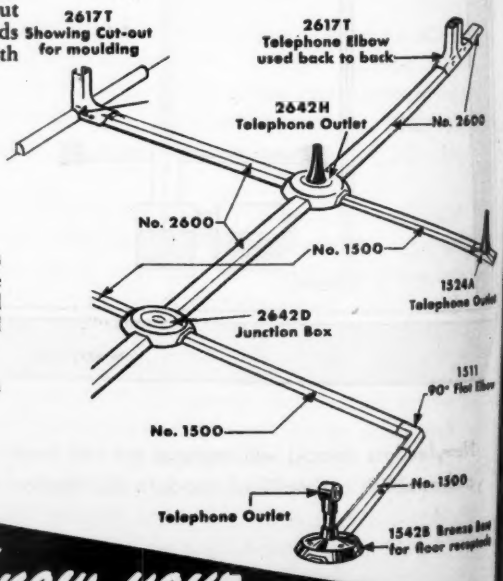
When this happens . . . as it does every day in busy office buildings . . . will there be costly delays and confusion in re-connecting telephone, communications, and light and power services to desks? Not if you install "Pancake" . . . the Wiremold Overfloor Wiring Systems designed for just this purpose.

PANCAKE SOLVES THE WIRING PROBLEM

PANCAKE

"Pancake" Overfloor Wiring Systems . . . "flat as a pancake; strong as a bridge" . . . are available in two sizes, No. 1500 with a capacity of 4 No. 12 and No. 2600 with a capacity of 2 26-pair telephone cables. Together, these two sizes of raceway and their fittings permit complete, efficient, and speedy layout of wiring for all telephone or power and light service needs in offices. Later additions, extensions, changes are made with time- and cost-saving facility.





AND HERE IS HOW IT IS DONE



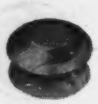
1524 Telephone Outlet

Base of "Pancake" Raceways provided with screw knockouts for easy installation. Slip-joint connections to fittings insure electrical bonding. Wiring is laid in and cover sections snapped on to complete installation. Raceways and Fittings are designed to meet telephone company requirements.

Write us today for bulletins describing installation and use in detail. The Wiremold Company, Hartford 10, Conn.



1542B Receptacle Base



1542D Junction Box



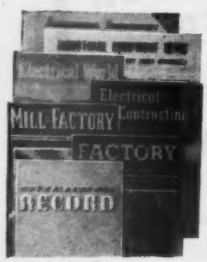
2642D Junction Box



2642H Telephone Outlet



2617T Telephone Elbow



ELECTRICAL CONTRACTORS

Business publications like these, with aggregate circulation of over 240,000 monthly among your prospects and customers, carry Wiremold advertising messages designed to HELP YOU BUILD BUSINESS. Tie in with this aggressive promotion program

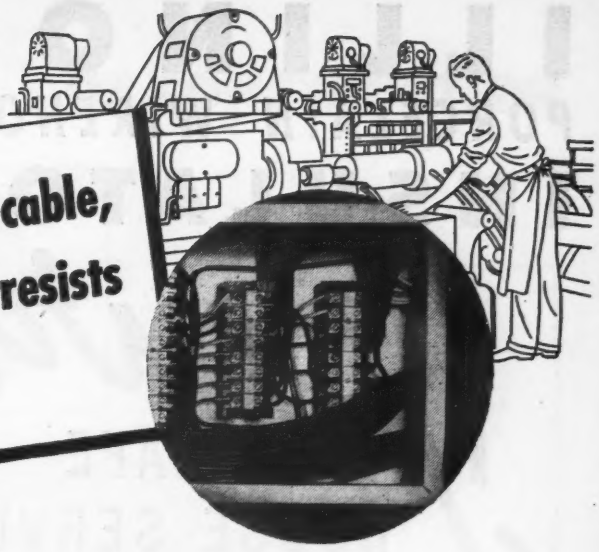


Know your WIREMOLD

NEMA

BUSINESS BUILDER IN TOMORROW'S MARKET FOR ADEQUATE WIRING

PROBLEM: to find insulated cable, for wiring machine tools, which resists all kinds of cutting fluids



First solved with FLAMENOL *cable*

● Not long after the introduction of Flamenol*, in 1935, a prominent manufacturer of automobiles was searching for insulated cable which would withstand machine-tool cutting oils and coolants. When a G-E sales engineer showed the manufacturer a sample of Flamenol—and described its excellent resistance to oils, water, and heat—the company's chief electrician immediately ordered 6000 feet. The company found this cable so satisfactory that it now specifies Flamenol to be installed on all the machine tools it buys. If you have a problem of finding insulated cable or wire that will withstand severe conditions, such as contact with cutting fluid, Flamenol may very likely be the answer. It has proved its many desirable properties in hundreds of power and lighting applications.

RESISTS FLAME—Flamenol does not support combustion. Thus, it prevents serious outages due to fires that involve wiring. Requiring no protective braid, it reduces the volume of wiring and eliminates terminating problems due to fraying. Flamenol's insulation strips easily and leaves the conductor surface untarnished. It is highly resistant to oils, water, mild acids and alkalis, and weather. It is tough, stable, and flexible at low temperatures, and has high dielectric strength.

A G-E "FIRST"—Only G.E. makes Flamenol wire and cable. Flamenol is the pioneer of wire and cable insulated with plasticized polyvinyl chloride. It was produced by G.E. in 1935—not as a substitute for rubber-insulated wire, but as a new type possessing desirable properties not available with rubber. To find out how Flamenol can help solve your problems—save you time, trouble, and expense—ask our local office, or write General Electric Company, Schenectady 5, N. Y.

*Trade-mark reg. U.S. Pat. Off.



GENERAL ELECTRIC

502-52-1200

Buy all the BONDS you can—and keep all you buy

ILLINOIS
PORCELAIN WIREHOLDER
INSULATORS

Insure
SAFE HOUSE SERVICE CONNECTIONS..



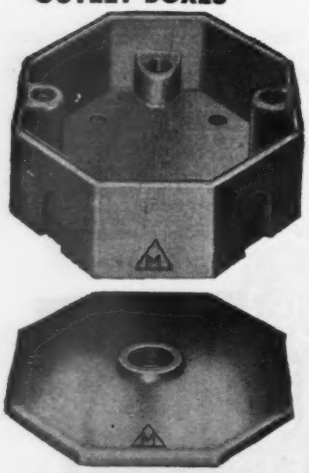
• When you use Wireholder Insulators with the name "ILLINOIS" you are backing up your work with the right quality for the job.

All corners are rounded to prevent injury to the insulation of the wires. The screws have deep, sharp threads for easy installation. The screws are fastened into the insulators with non-shrinking metal alloy. The all-steel screws are hot galvanized by a special process to insure a smooth, even coating. Will not cause rust streaks on the sides of buildings. These dry process wireholders are made in sufficient styles and sizes to meet all requirements. Wet process porcelain supplied on special order.

ALL-PORCELAIN ILLINOIS SYSTEMS *for*

outstanding, adequate and modern wiring jobs

OUTLET BOXES



Glazed and unglazed styles conforming to all existing standards of dimensions, spacing, position of knockout holes, and mounting screws. High mechanical and electrical efficiency.

SWITCH BOXES



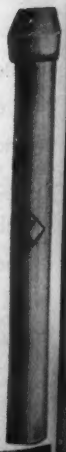
Insure greater safety in wiring and the elimination of all grounding hazards. Made of the best quality of white porcelain. Metal inserts are placed in two holes of the switch boxes for receiving screws of standard switches, plug outlets, etc. Knockouts for single wires, also for cables. Specify and use them.



Bull Dog

KNOBS

Cement coated — extra length nail—genuine leather washer — code standard. They don't chip when driven in and they do stay in place and have a firm grip. Available in a wide variety of heights, diameters, holes, and grooves.



STANDARD TUBES

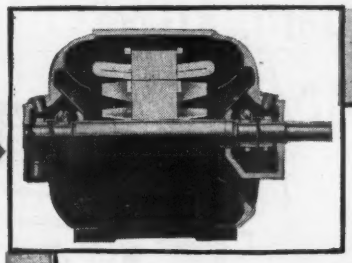
In sizes ½ to 48 inches long, 5/16 to 3 inches diameter in following types: unglazed, glazed, split, floor, split floor, headless, curved and, crossover split, and cross over. Diameters all uniform both inside and outside.

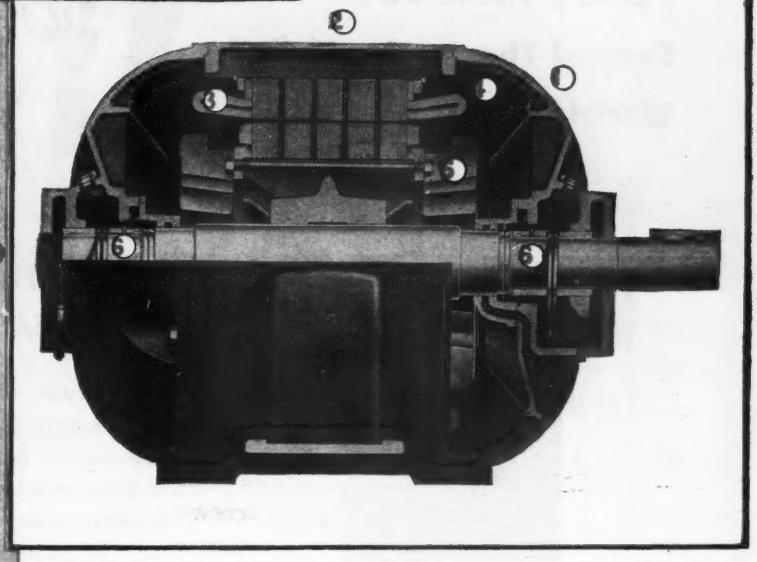
ILLINOIS ELECTRIC PORCELAIN COMPANY *Macomb, Illinois*

SAME STRONG POINTS OF CONSTRUCTION

from 1 hp

to 2000 hp





Now all your drives — large and small — can have standard G-E Tri-Clad induction motors with the famous protective features that guard against PHYSICAL DAMAGE, ELECTRICAL BREAKDOWN, OPERATING WEAR AND TEAR.

Tri-Clad, in its wide range of types and sizes (recently increased to 2000 hp), is G.E.'s most widely used (integral-hp) motor. For complete details on ratings, characteristics, and dimensions, write for Bulletin GEA-3580. Apparatus Dept., General Electric Company, Schenectady 5, N. Y.

HERE'S TODAY'S WIDER RANGE OF STANDARD SIZES	
Tri-Clad Type K (Low starting current, normal starting torque)	1 hp to 2000 hp at 1800 rpm
Tri-Clad Type KG (High starting torque, low starting current)	5 hp to 200 hp at 1800 rpm
Tri-Clad Type KR (High starting torque, high slip)	Available to 100 hp in speeds required for high-slip flywheel drive (punch press, etc.)

1. Cast-iron frame and rigid, cast-iron end shields protect the motor from external blows and accidental abuse.
2. Completely enclosed upper portion of frame guards against entry of falling objects and dripping liquids; keeps chips and the like from vital motor parts.
3. Windings of Formex* wire—one of the toughest magnet wires yet developed—resist heat aging, heat shock, and abrasion.
4. End windings are coated with Glyptal* varnish, providing a tough, hard finish that withstands moisture, oil, and abrasion.
5. Low-velocity, double-end ventilating system keeps the motor running cool and prolongs insulation life. One-piece, cast-aluminum rotor (used on all but the largest sizes), with integrally cast fans, is practically indestructible.
6. Bearings have extra capacity to take heavy shaft loadings from any direction. Lubrication is convenient, its effectiveness well proved.

*Trade-mark reg. U. S. Pat. Off.

TRI CLAD MOTORS

Buy all the BONDS you can — *and keep all you buy*

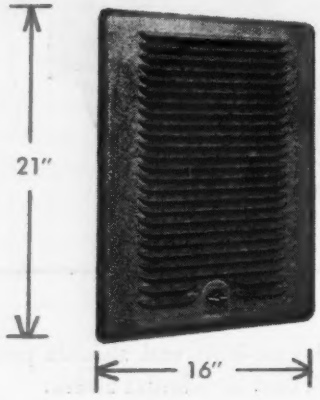
750-386-8050

GENERAL ELECTRIC

FOR THE "HOME OF TOMORROW" THEY'RE BUILDING TODAY....



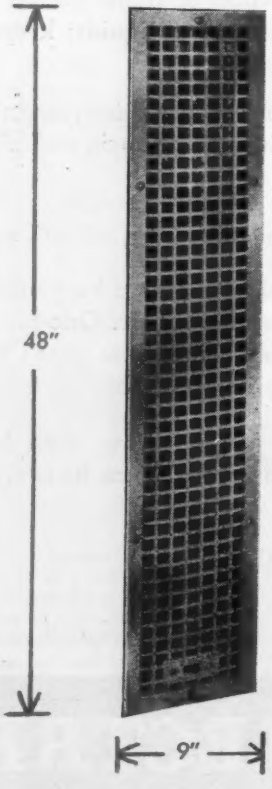
Specify These Two Proved Thermador Built-In Electric Heaters



THE BUILT-IN FAN TYPE ELECTRIC ROOM HEATER*

Fills the room with a flood of air, less than 2 degrees difference between ceiling and floor temperature. Finished in Moroccan Brown or with primer which can be painted to match interior trim. Only 16" by 21", it can be installed between studs, and needs only 4" in depth. In summer, with the heating element off, and the fan on, this versatile heater floods the room with welcome circulating air. Manually or thermostatically controlled.

2, 3, and 4 thousand Watts, 230 Volts



THE "HEAD-TO-HEELS" ELECTRIC BATHROOM HEATER*

Sleek, slender and simple, this modern, fumeless, flameless bathroom heater can be fitted into any bathroom. It is 48" in height and only 9" wide, and needs but 4¼" of depth. Since it is electric, it is installed without a flue or vent—heavy chrome finish, ceramic insulators. Made by Thermador, the oldest and largest electrical appliance manufacturer in the west.

1650 Watts—115 or 230 Volts

2000 Watts—230 Volts

***NOW IN PRODUCTION**



THERMADOR

Electrical Manufacturing Company

5119 SOUTH RIVERSIDE DRIVE • LOS ANGELES 22, CALIFORNIA

WHY you need this SILENT PARTNER in your fixture business



THE QUIET OPERATION of G-E ballasts reduces noise complaints and promotes customer good will

G-E BALLASTS are so designed and built that hum (present to some degree in all a-c devices) has been reduced practically to the point of inaudibility.

For example, the ballast coils are *machine* wound to eliminate "springy layers," and to provide units of unvarying rectangularity. The cores are stacked automatically from high-quality, low-loss steel laminations that are cut to exact dimensions. Thus, precisely the right amount of core steel can be fitted snugly around each coil, and firmly clamped into position to prevent "play" or shifting of parts—so often a contributing cause of noise.

In addition, after all the various ballast components are assembled in a mechanically strong clamping frame, they are impregnated in a moisture-resistant varnish, and cured by baking, and housed in an unusually heavy-gage steel case. A special compound, that sets like asphalt, is poured (while hot and fluid) over and around all the assembled parts, filling all air pockets and voids and sealing the components to each other and to the ballast case. The result is a solid, cohesive ballast without noise troubles.

As a final precaution, one of the many tests which every G-E ballast must pass is an exacting noise test.

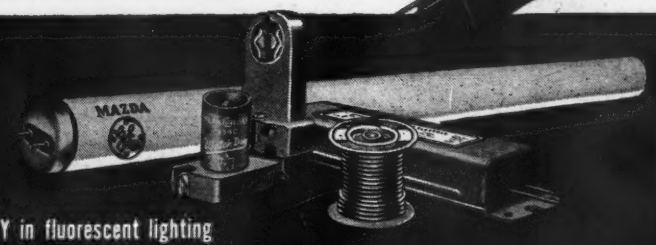
It is attention to details of this sort, and quality control during manufacture, that are responsible for the fact that, of the 16,000,000 G-E ballasts installed since 1938, 99.5 per cent are still giving quiet, successful service.

Write for Bulletin GEA-3293F for data on our complete line of ballasts for fluorescent lighting. *General Electric Company, Schenectady 5, New York.*

These ballast features help keep fixture users satisfied—they mean added profits for you

1. Low noise level—for satisfied users
2. Long life—for low replacement cost
3. Characteristics matched with lamp—for rated lamp life and light output
4. Dimensions that permit use of one wiring channel for practically all fixtures—for simplified parts inventory and lower fixture cost



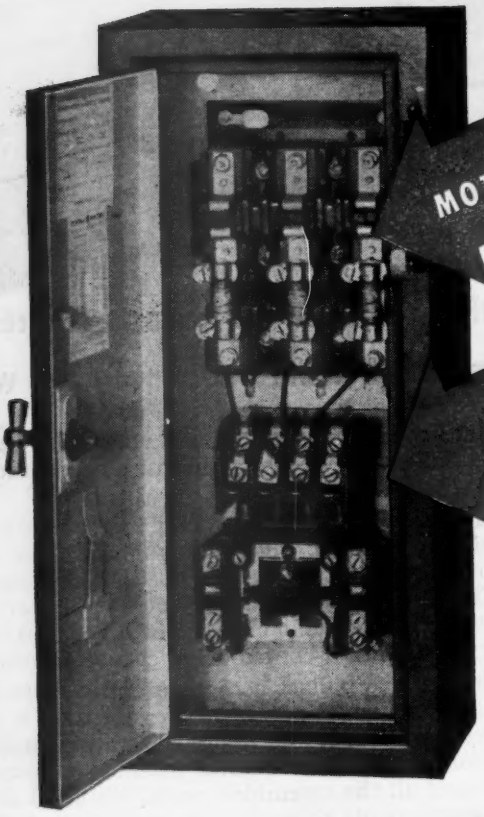


BALLASTS
LAMPS
STARTERS
LAMPHOLDERS
CABLE—stand for DEPENDABILITY in fluorescent lighting

Buy all the BONDS you can
—and keep all you buy

Motor Starters

TWO DEVICES IN ONE UNIT



INDUSTRIAL CONTROL

G.E. RECOMMENDS COMBINATION STARTERS because they HELP YOU SAVE 6 WAYS

1. 50% ***reduction in mounting time***—You mount only one device, not two.
2. 40% ***reduction in wiring time***—Connect to only 9 terminals, not 15. The switch and starter come already connected.
3. ***Increased safety***—Cover cannot be opened while there is power on the starter.
4. ***Conserve man power***—by eliminating one complete mounting job on every installation.
5. ***Saving of wall space***—The one device takes less space than two.
6. ***Save critical materials***—Combination starters require less wire and steel conduit and fewer fittings than separately mounted devices.

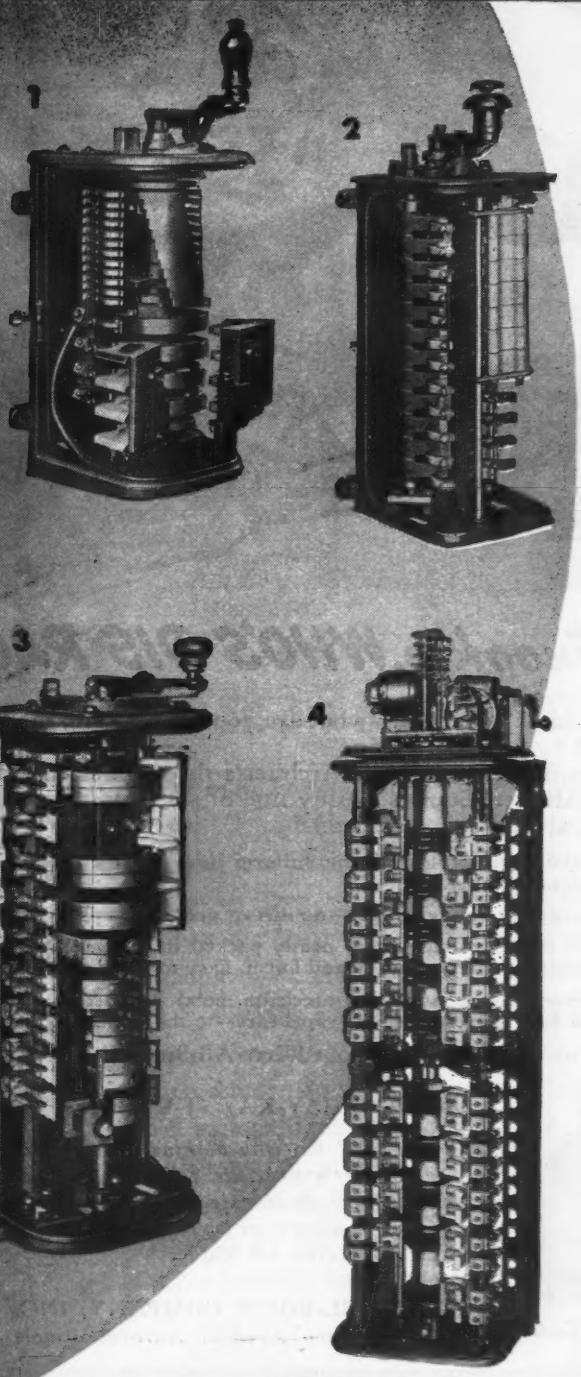
And remember, whatever your plant's operating conditions, you can get a combination control to fit it. This means a motor-circuit switch (with short-circuit protection) and a magnetic starter—in one, compact, easy-to-mount unit.

EVERY TYPE, EVERY SIZE, FOR EVERY MACHINE APPLICATION

★ DEPENDABLE

★ ATTRACTIVE IN APPEARANCE

★ DESIGNED TO BLEND WITH MODERN MACHINES



1. D-C DRUM SWITCH

For use with reversible or nonreversible d-c motors. Recommended where frequent motor-starting, stopping, and speed adjustment are necessary.

2. A-C CAM-TYPE DRUM SWITCH

Suitable for starting or reversing service on small cranes, hoists, machine tools, and similar applications. These drum switches (with primary resistance) will control squirrel-cage motors.

3. A-C REVERSING DRUM SWITCH

Designed for severe duty controlling large wound-rotor induction motors which operate cranes, hoists, bending rolls, etc.

4. MOTOR-OPERATED, A-C DRUM SWITCH

For secondary control of wound-rotor motors that have three-phase secondaries. Designed for either remote operation, or as an automatic control when used with a pilot-circuit device.

5. DRUM SWITCH FOR SMALL A-C MOTORS

Recommended for starting or reversing small wound-rotor motors—provides dependable operation.

NAME YOUR APPLICATION

Whether manual or magnetic controls are needed, our engineers are at your service and will be glad to assist you in selecting the correct starter for your application. Get in touch with your local G-E office, or write to us directly. *General Electric Company, Schenectady 5, N. Y.*

Buy all the BONDS you can—and keep all you buy

GENERAL ELECTRIC

670-185-5010



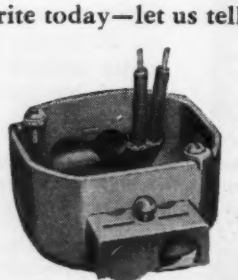
Say, Snookie, WHO'S DIS RACO Guy?

● "Ease up a bit and I'll tell you—what are you tryin' to do, make me look like a bum? It's de line that's sold by All-Steel-Equip."

Right—Builders, Contractors, and Architects throughout America know that Raco is the famous name of All-Steel-Equip's quality line of steel switch boxes and outlet boxes. Here's why you also can always rely on Raco:

- It's the dependable line, the uniform line, the line that's sold nationally by wholesalers only.
- No jagged or rough edges—no dirt or grease. Smooth, attractive appearance!
- Every Raco product comes neatly packed in a protective carton, with index showing number, quantity and finish. Easy to stock and identify.
- All-Steel has been making precision metal products for over 33 years. The Raco line is made with the same care—to the same exacting standards!

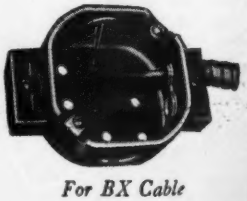
Write today—let us tell you more about Raco • All-Steel • Products.



For Non-Metallic Cable

THE JAY-KAY (J-K) BOX

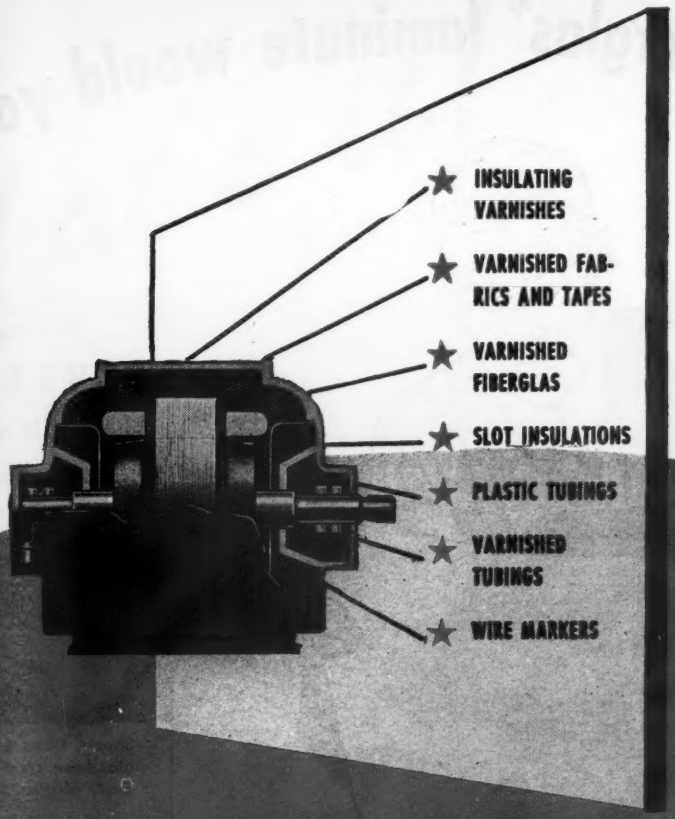
Made for "BX" but with bushing plate removed, it becomes a box for non-metallic cable. Supplied in 3¼" and 4" diameters. Boxes only, or assembled on bars; external clamps allow more wiring room. Use this box now when connectors are scarce.



For BX Cable

ALL-STEEL-EQUIP COMPANY, INC.
600 Kensington Avenue, Aurora, Illinois

RACO • ALL-STEEL • PRODUCTS
SWITCH BOXES • OUTLET BOXES



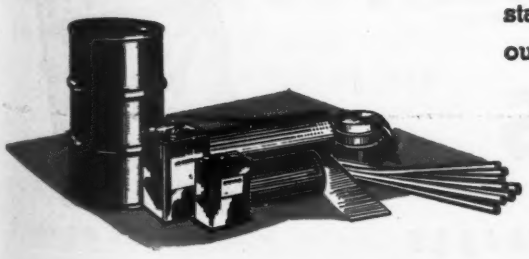
Completely INSULATED

by the Leader in Insulation!

Motor manufacturers have come to the realization that the specification "Completely Insulated by Irvington" means longer motor life with less chances of electrical failures. Basic to this is the fact that every Irvington insulation has been formulated to produce definite and outstanding characteristics — resistances to the agents of motor destruction — heat, corrosive fumes, excessive moisture, etc. Insulations have been designed for regular and unusual motor needs — matched to work with each other for blended, smooth acting motor performance — to produce long-lasting and dependable motors. From this one source, *Irvington*, you can obtain insulations not only for motors but for all other electrical equipment as well. Each and every product is kept to Irvington's high standards by strict laboratory and production control. We offer our cooperation and invite your inquiries. Write Department 96

IRVINGTON PRODUCTS include:

Core Plate, Finishing and Sticking Varnishes • Varnished Canvas and Duck • Varnished Nylon, Rayon and Silk • Varnished Papers • Insulating Punchings • Fibron Plastic Tapes • Cardolite Compounds



IRVINGTON
VARNISH & INSULATOR COMPANY
Irvington 11, New Jersey, U. S. A.

What kind of Fiberglas* laminate would you use?



Fiberglas-base laminates are made with many different kinds of resins—to meet a wide range of electrical and mechanical requirements. The finished materials may be obtained in sheet form, in rods or tubes, or may be molded or shaped to special forms.

Laminates with *Fiberglas Cloth* as a base are used in large volume for motor and generator applications. Their temperature limits and moisture resistance vary with the type of resin used. They have high dielectric strength.

Where minimum space and high strength are required, Fiberglas-base laminates are usually used. Typical applications are aircraft generators, dynamotors, etc.

Laminates with *Fiberglas Mat* as a base are used primarily by radio and electronics industries. The Fiberglas Mat in combination with resins provides dimensional stability, moisture resistance, temperature resistance and adequate mechanical strength for high-frequency, low-electrical-loss parts.

Most manufacturers of electrical laminates make one or more types of Fiberglas-base products.

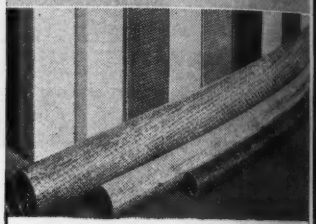
Complete Information

The new Fiberglas catalog EL 44-7 gives performance and application data of importance to anyone concerned with electrical insulation. It contains facts about each of the many types of Fiberglas-base materials which are providing better, "High Safety Factor" insulation. Write for your copy today. *Owens-Corning Fiberglas Corporation, 1856 Nicholas Building, Toledo 1, Ohio.*

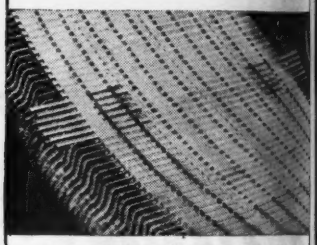
In Canada, Fiberglas Canada Ltd., Oshawa, Ontario.

Each distributor of Fiberglas-base Insulation Materials has his own source of supply, since Owens-Corning Fiberglas Corporation does not process these materials.

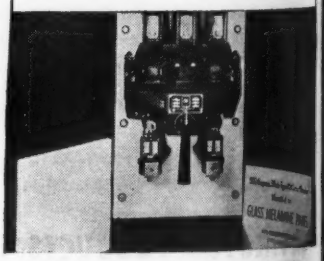
There is a FIBERGLAS Insulation Material for every need



Sheets, tubes and rods of Fiberglas-base plastics are made by many plastics producers.



In sheet form Fiberglas laminates are made in thicknesses from 1/32" to 3/16". Greater thicknesses are used for panel and switchboard material.



Fiberglas Cloth is used with Melamine to produce this circuit breaker panelboard. Has astounding impact strength and exceptional electrical characteristics.

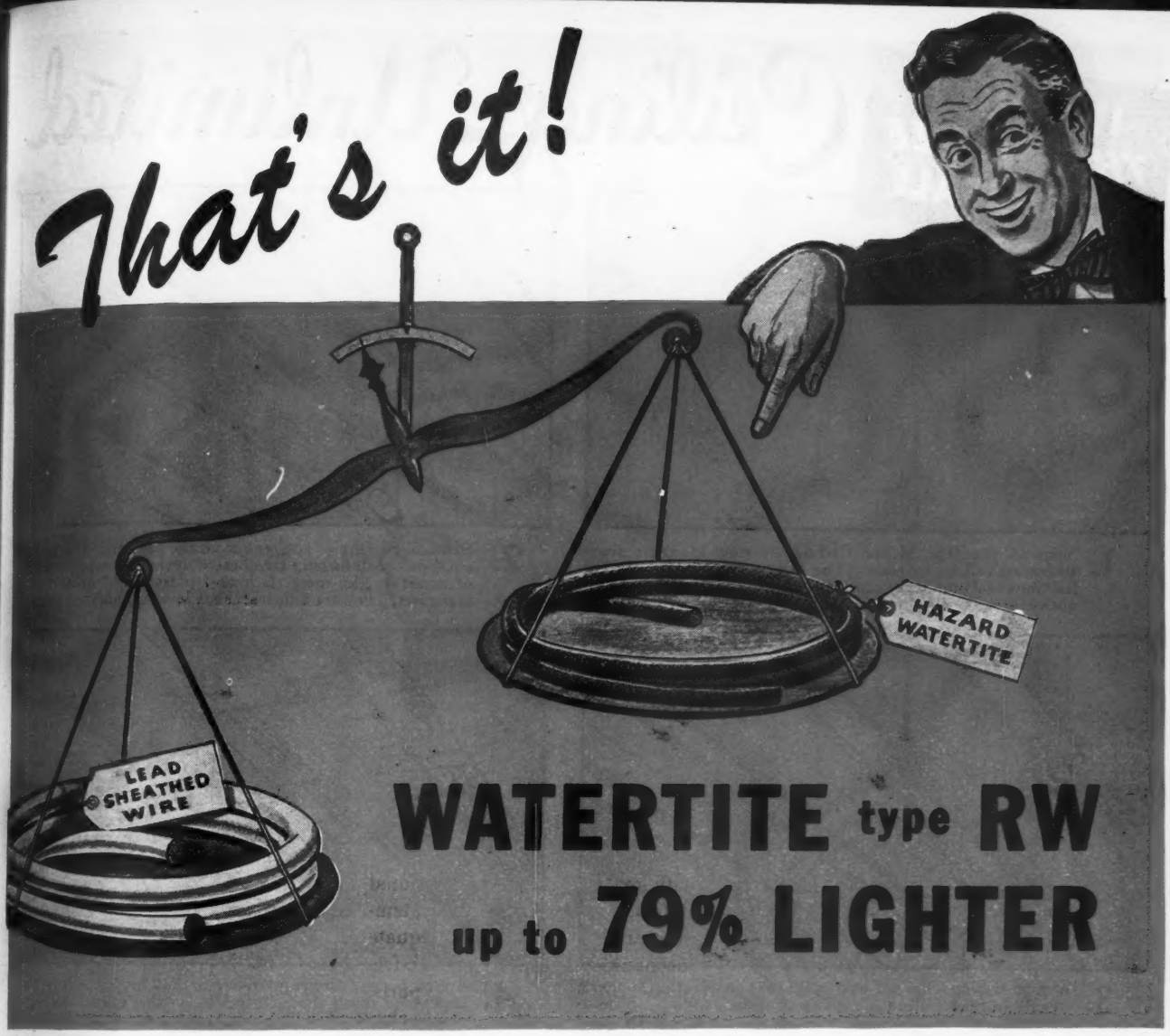
FIBERGLAS

*T. M. Reg. U. S. Pat. Off.

ELECTRICAL INSULATION MATERIALS



Write for catalog EL 44-7, today.



WATERTITE type RW
up to 79% LIGHTER



HAZARD

insulated wires and cables for every electrical use

In wet locations *that's* the kind of cable to handle!

- Light to carry — easy to work with
- Same splicing methods used as on any other easy stripping insulated wire
- No lead wipes required
- Faster installation saves time
- Smaller diameters make use of smaller ducts possible

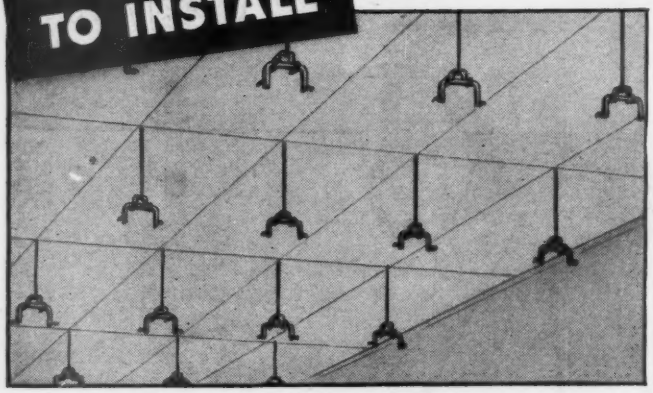
... and it all adds up to lower cost for the man who pays the bill.

Watertite has full National Electrical Code approval for wiring in damp locations, according to Section 3035. The strong, tough, moisture-resistant insulation has a high tensile strength. Voltage limit is 5000 volts; temperature limit is 50° C. Available in all sizes. Hazard Insulated Wire Works, Division of The Okonite Company, Wilkes-Barre, Pa.

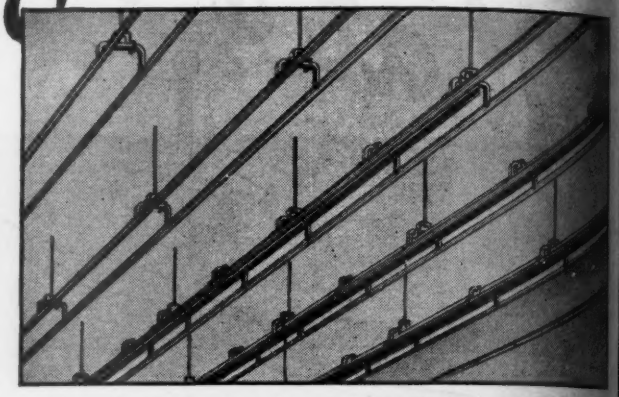
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FOR INDOORS • OUTDOORS • SUBMARINE USE

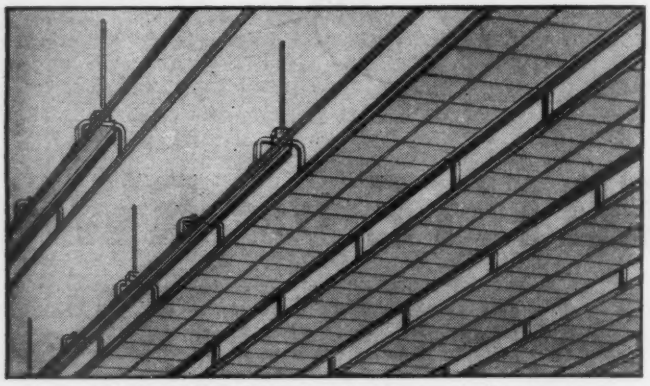
IT'S JUST THIS SIMPLE TO INSTALL Ceilings Unlimited



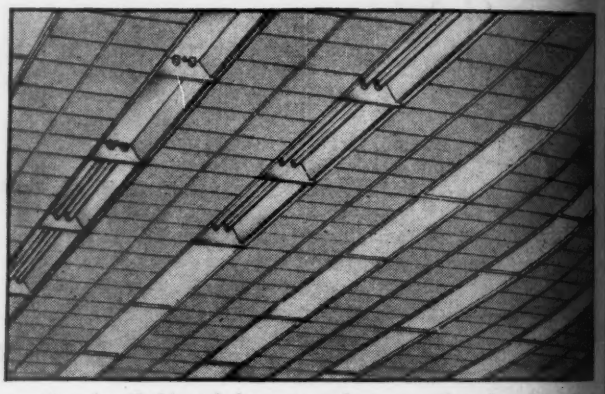
1. Suspend patented Miller Ceiling Furring Hangers from structural ceiling by rods. (The Miller System requires but half the usual number of supports... economy, plus more space above furred ceiling for air conditioning ducts, piping, etc.)



2. Suspend Furring of any type from the hangers. (Hangers are equipped with furring attachment devices to support furring of acoustic tile, metal lath and plaster and other ceiling materials. They are adjustable for leveling finished ceiling.)



3. Mount wiring channel and reflectors inside the hangers, install finished ceiling tile. (The continuous wireway channel and other Miller engineering features cut wiring costs up to 50%, conduit and conduit installation costs up to 80% —as well as many other really startling economies.)



4. Attach hinged doors to reflectors, swing them into place, lock—and that's that. (It really *is* "that's that" for Miller Fluorescent Troffer Lighting Systems are designed to solve old furring problems—without creating any *new* ones.)

Miller Fluorescent Troffer Lighting Systems

for stores, schools, offices and public buildings

The 8-foot, 4-foot or 2-foot Troffer sections may be easily combined to form innumerable patterns of practically any dimension (of two-lamp type with removable hinged doors or single-lamp ALZAK aluminum type with louvre shielding).

This versatility provides the architect with practicable instruments of expression. It is now *engineeringly* (as well as esthetically) sound to plan entire buildings—*around the lighting.*

All this is but part of the fascinating story of Miller Fluorescent Troffer Lighting Systems. The whole story is told in "CEILINGS UNLIMITED", a big new brochure—catalogue, complete with photographs, architects' renderings, working drawings and specifications.

Miller engineers, located in principal cities, will be glad to provide you with a copy—or you may write directly to The Miller Company.

THE MILLER COMPANY • MERIDEN, CONNECTICUT

MILLER SINCE 1844

ILLUMINATING DIVISION
Fluorescent, Incandescent
Mercury Lighting Equipment

HEATING PRODUCTS DIVISION
Domestic Oil Burners
and Liquid Fuel Devices

ROLLING MILL DIVISION
Phosphor Bronze and Brass
in Sheets, Strips and Rolls

WAR CONTRACTS DIVISION
War Materiel

FOUNDRY DIVISION
Non-Ferrous Metal Castings


CENTRAL
RIGID STEEL
CONDUIT
MEANS
DEPENDABILITY
LONG LIFE
CENLACO (HOT DIPPED)
SPANG-CHALFANT
CENLACO
UNDERWRITERS' LABORATORIES, INC. INSPECTED RIGID STEEL CONDUIT
"There's Tested Strength in Every Length"
CENTRAL BLACK
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UNDERWRITERS' LABORATORIES, INC. INSPECTED RIGID STEEL CONDUIT
SPANG-CHALFANT
Division of The National Supply Company
General Sales Office: Grant Building, Pittsburgh 30, Pa.
District Offices and Sales Representatives in Principal Cities



SOIL CORROSION MEETS ITS MATCH!

Transite Ducts, immune to rust and rot, actually get stronger with age

HERE'S a ductway which effectively withstands the corrosive action of all types of soil normally encountered in cable installation.

This advantage of Transite Ducts is shown in a series of tests conducted over a two-year period by an independent research agency. Through cinder fills, salt marshes, peat bogs, clay, loam and many other aggressive soils, laboratory men found that these asbestos-cement ducts actually became stronger, more durable with age.

As an added factor, underground cables encased in Transite are *cooler* cables because this inorganic material dissipates heat more rapidly than ducts with an organic content. Thus cable life is lengthened.

The permanently smooth bore of Transite Ducts makes long cable pulls easy and speeds up replacements. These ducts come in long, lightweight lengths, easy to handle and install.

* * *

For details, write for Data Book, DS410, Johns-Manville, 22 E. 40th Street, New York 16, N.Y.

JOHNS-MANVILLE JM PRODUCTS

Johns-Manville

There is an office near you

TRANSITE DUCTS

CONDUIT for use without concrete

KORDUCT for concreting in

CROUSE-HINDS

FLOODLIGHTS

The illustrations show a representative selection from the dozens of different Crouse-Hinds floodlights — each designed for its particular purpose. Crouse-Hinds lighting engineers will recommend the proper selection and arrangement of floodlights for any application. Send drawings and details.

No. 4
of a series of advertisements which demonstrate that CROUSE-HINDS "complete line" means much more than just a range of sizes—there is a wide variety of highly specialized types in each classification.


Type MDB-8
100-Watt


Type MDB-10
200-Watt


Type MDB-14
500-Watt


Type MDB-16
1000-Watt


Type MUA Elliptalux
750 to 1500-Watt


Type MUA Alumalux
750 to 1500-Watt

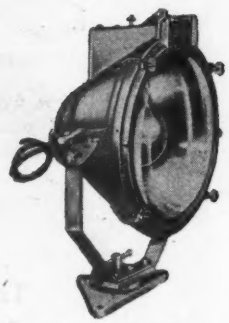

Type ADE-12
Heavy Duty
200 or 250-Watt

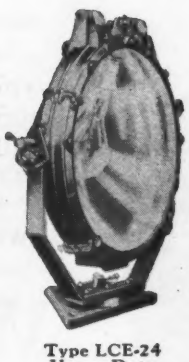

Type ADE-14
Heavy Duty
500-Wall


Type ADE-16
Heavy Duty
1000-Watt


Type ADR-14
Heavy Duty
Portable 500-Watt


Type RCDE-8
Explosion-Proof
Portable
200-Watt

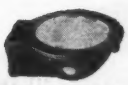

Type LCE-1120
Heavy Duty
1500-Watt


Type LCE-24
Heavy Duty
2000-Watt


Type RCDE-8
Explosion-Proof
200-Watt


Type RMC-8
Wall Mounting
100-Watt

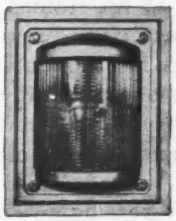

Type RCD-8
Wall Mounting
100 to 200-Watt

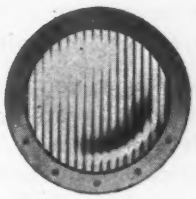

Type RCD-8
Floor Mounting
100 to 200-Watt


Type RMF-12
Wall Mounting
150 or 200-Watt

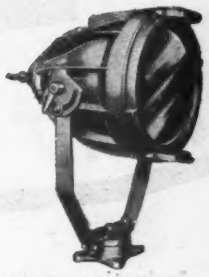

Type FS
Floor Lighting
25-Watt

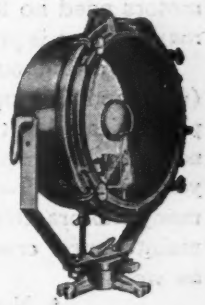

Type VCD-6
Roadway Lighting
60 to 100-Watt


Type VCD-12
Roadway Lighting
200-Watt


Type SPS for
underwater lighting
of swimming pools


Type GCP-14 Lantern
300 to 1500-Watt


Type RLEE-14
Explosion-Proof
500-Watt


Type DCE-18
Long-Range Searchlight


Type DCX-18
Long-Range Searchlight

A Nationwide Distribution Through Electrical Wholesalers

CROUSE-HINDS COMPANY
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CONDULETS · TRAFFIC SIGNALS · AIRPORT LIGHTING · FLOODLIGHTS

now... on a wider range of motors

don't lubricate for 5 years or more

up to 15 hp

Induction motors—always an easy responsibility for maintenance crews—are now simpler than ever. Now, in sizes up to 15 hp, Westinghouse squirrel-cage motors need no lubrication for 5 years at least and maintenance is practically negligible.

All Westinghouse squirrel-cage ball bearing motors (CSP and CS) up to 15 hp, frames 203 to 326, are prelubricated at the factory and sealed so they need not even be inspected for lubrication until after 5 years of 24-hour-a-day operation. In operations using many motors, this saves a large amount of time for maintenance crews and brings other advantages, as well:

- No overgreasing
- No "skipped" bearings
- No grease contamination
- No grease seepage
- No unreplaced pipe plugs

With all these advantages, you can install motors and work them hard for 5 years or more with no attention. For complete information, write for Bulletin B-3554 and Descriptive Bulletins 3100-CSP and 3100-1 to Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa. J-21329



Type CS motor has prelubricated sealed ball bearings, frame sizes 254 to 325.



Type CSP motor has prelubricated sealed ball bearings, frame sizes 203 to 225.



Another Westinghouse motor "First" — the lubrication label that says, "Don't lubricate for 5 years or more."

Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

SQUIRREL-CAGE MOTORS



Every floor promoting

more and more electricity

Each floor is *potentially* alive with electricity.

That is, it is so constructed that an electrician can establish an electrical outlet on any six-inch area. Wires can be criss-crossed within the whole floor.

These floors are Robertson steel Q-Floors. They are designed to encourage the use of more and more electrical equipment. This means more and more work for electricians.

Q-Floors are sold on the principle that a building which can stay electrically modern can maintain peak earnings over the years. To stay modern requires frequent change of floor plans. Each time outlets are rearranged and partitions moved, an electrician does the job.

Q-Floors increase electrical service.

H. H. ROBERTSON COMPANY

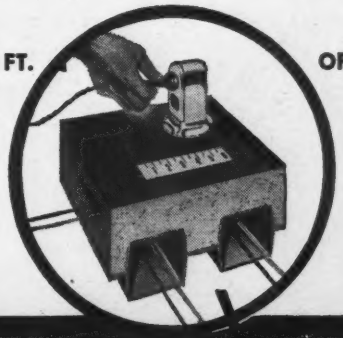
2400 Farmers Bank Building, Pittsburgh, Pennsylvania

Offices in 49 Principal Cities World-Wide Building Service

★ ★ ★

Electrical Fittings for use with Robertson Q-Floors can be obtained from General Electric Construction Materials distributors. See the nearest G.E. merchandise distributor for information on how Q-Floor fittings can be used to attain up-to-the-minute electrical wiring.

THIS IS 1 SQ. FT. OF Q-FLOOR



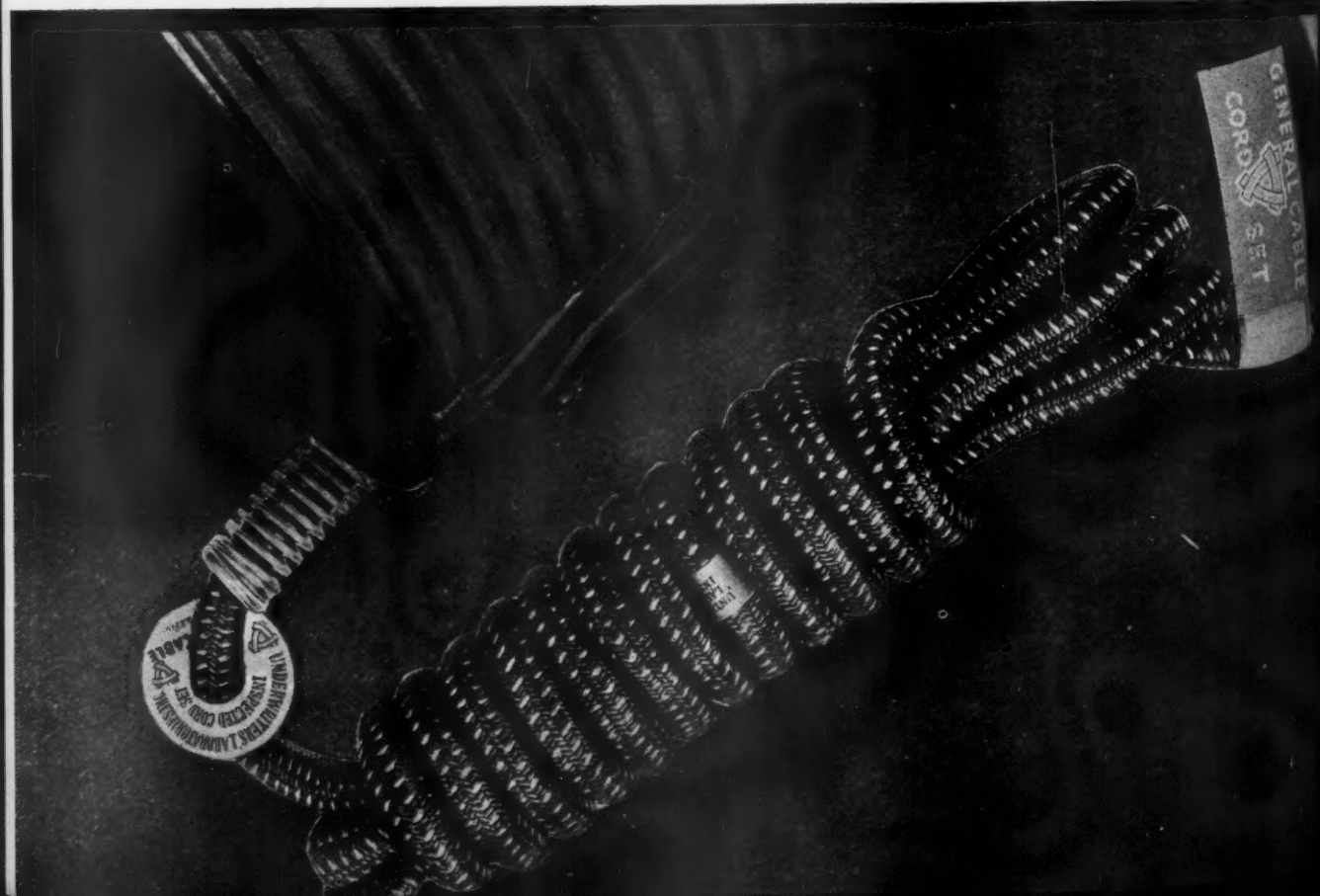
Q-FLOORS

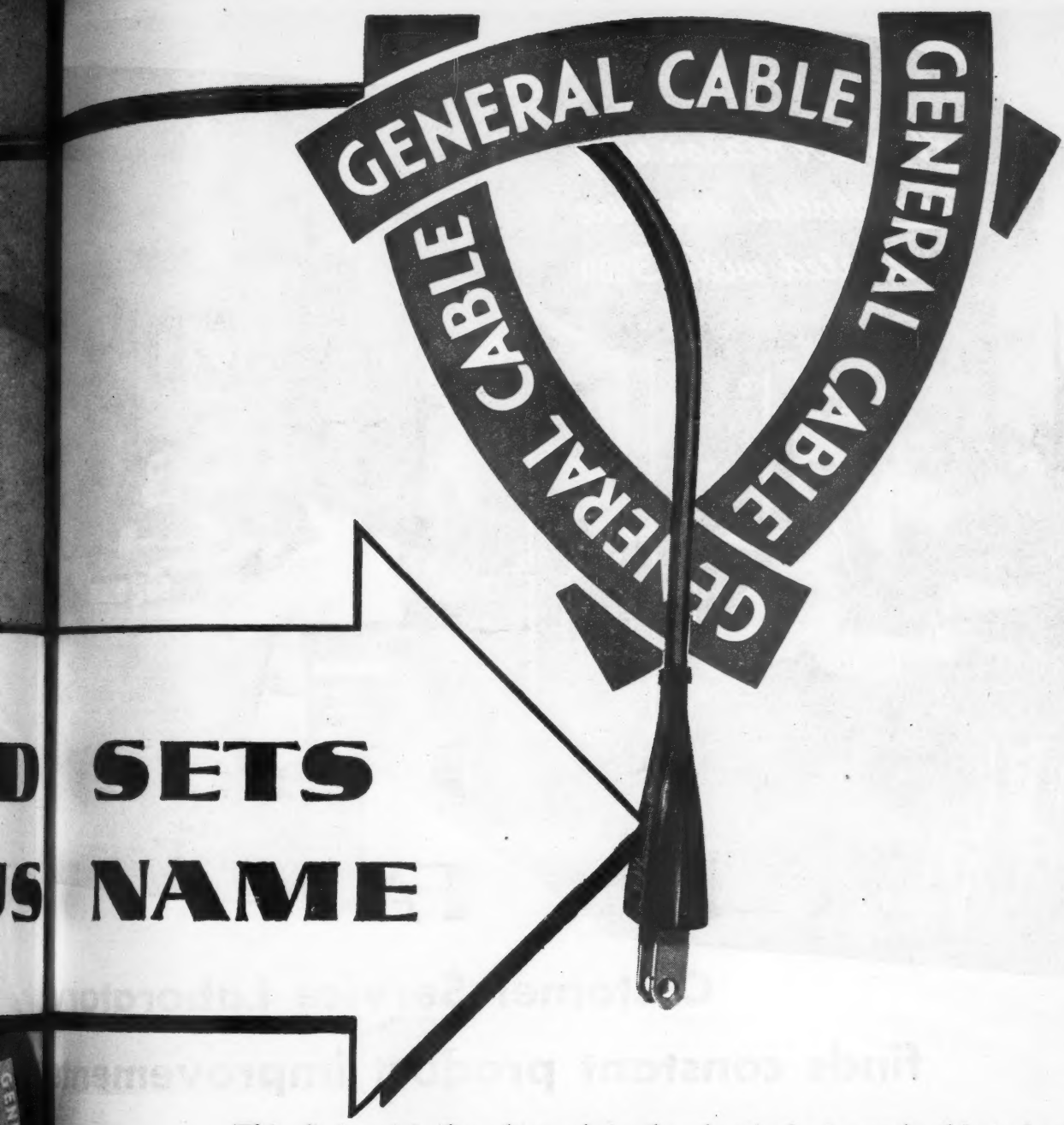


Again

CORDS AND CORD

WITH THIS FAMOUS





D SETS

JS NAME

This distinguished trade mark in the electrical wire and cable industry is once again the hallmark of quality on Cords and Cord Sets.

General Cable research and advanced engineering, plus expanded facilities and war-developed techniques have been adapted to the production of cords and sets that represent entirely new standards of quality and value.

Whatever your requirements may be, General Cable is now ready to serve you with a complete line of quality cords and cord sets.

GENERAL CABLE

CORPORATION

General Cable Corporation Sales Offices are located at Atlanta, Boston, Buffalo, Chicago, Cincinnati, Cleveland, Dallas, Detroit, Houston, Kansas City (Mo.), Los Angeles, New York, Philadelphia, Pittsburgh, Rome (N.Y.), St. Louis, San Francisco, Seattle, Washington (D. C.)



Customer Service Laboratory finds constant product improvements

THANKS to the efforts of the development staff in B. F. Goodrich Chemical Company's Customer Service Laboratory—thanks to their joint efforts with the country's leading wire and cable manufacturers—thanks to GEON polyvinyl materials—vast improvements are being made in wire insulation.

Consider the insulating materials of only a very few years ago. Then look at the many advantages offered by wire insulation made from GEON. Most important are superior electrical properties which permit thinner coatings of insulation—lighter weight, easier handling, more conductors per conduit, greater safety.

GEON's chemical properties provide insulation that resists water, oils and greases, most acids and chemicals, sunlight, aging, ozone, heat, cold, flame, and many other normally destructive factors.

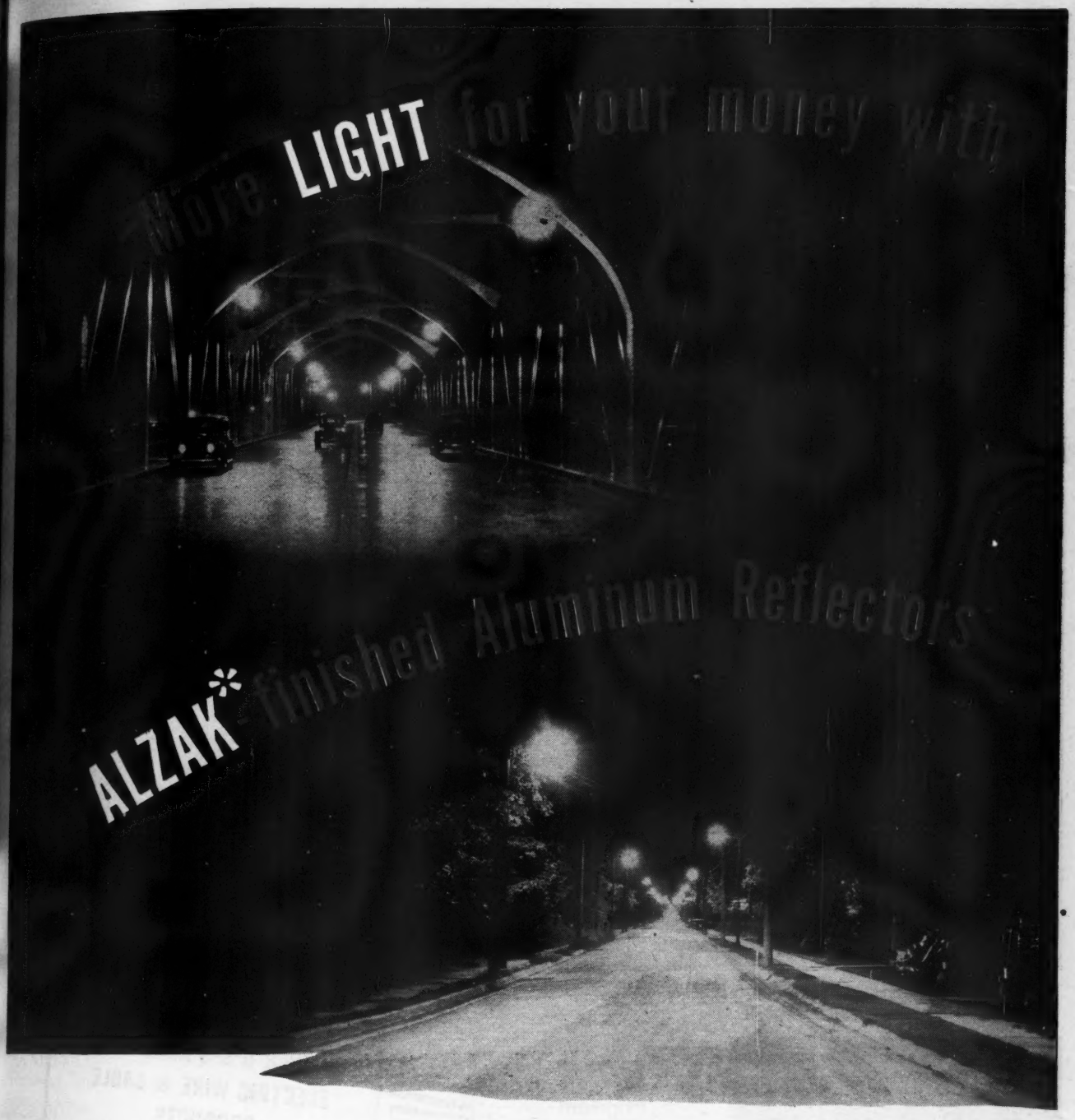
GEON's physical properties result in an almost indestructible material—thanks to high abrasion resistance and flex life. Insulation made from GEON is smooth—easy to handle, easy to install. It can be colored through the entire NEMA range. And its uses run all the way from slip-on "spaghetti" for fine radio hook-up wire to insulation for underground power cable.

Ask your supplier for wire and cable insulated with GEON. B. F. Goodrich Chemical Company, Department YY-11, Rose Building, Cleveland 15, Ohio.

Geon
Polyvinyl Materials

B. F. Goodrich Chemical Company

A DIVISION OF THE B. F. GOODRICH COMPANY



Maximum efficiency for your lighting system, long life and low annual costs—you gain these benefits by specifying Alzak-finished Aluminum light reflectors.

The high reflectivity of Alcoa's Alzak-finished lighting sheet, in combination with the reflector manufacturers' designs, accounts for this high efficiency. The ease with which Alzak reflectors can be kept clean enables you to maintain this efficiency throughout the life of the system.

Alzak reflectors come in various finishes; for indoor and outdoor work, for spot illumination and diffuse. In ordering your reflectors, be sure to specify the type of Alzak finish for each job. Your reflector manufacturer can meet those requirements.

ALUMINUM COMPANY OF AMERICA, 1946 Gulf Building, Pittsburgh 19, Pennsylvania.

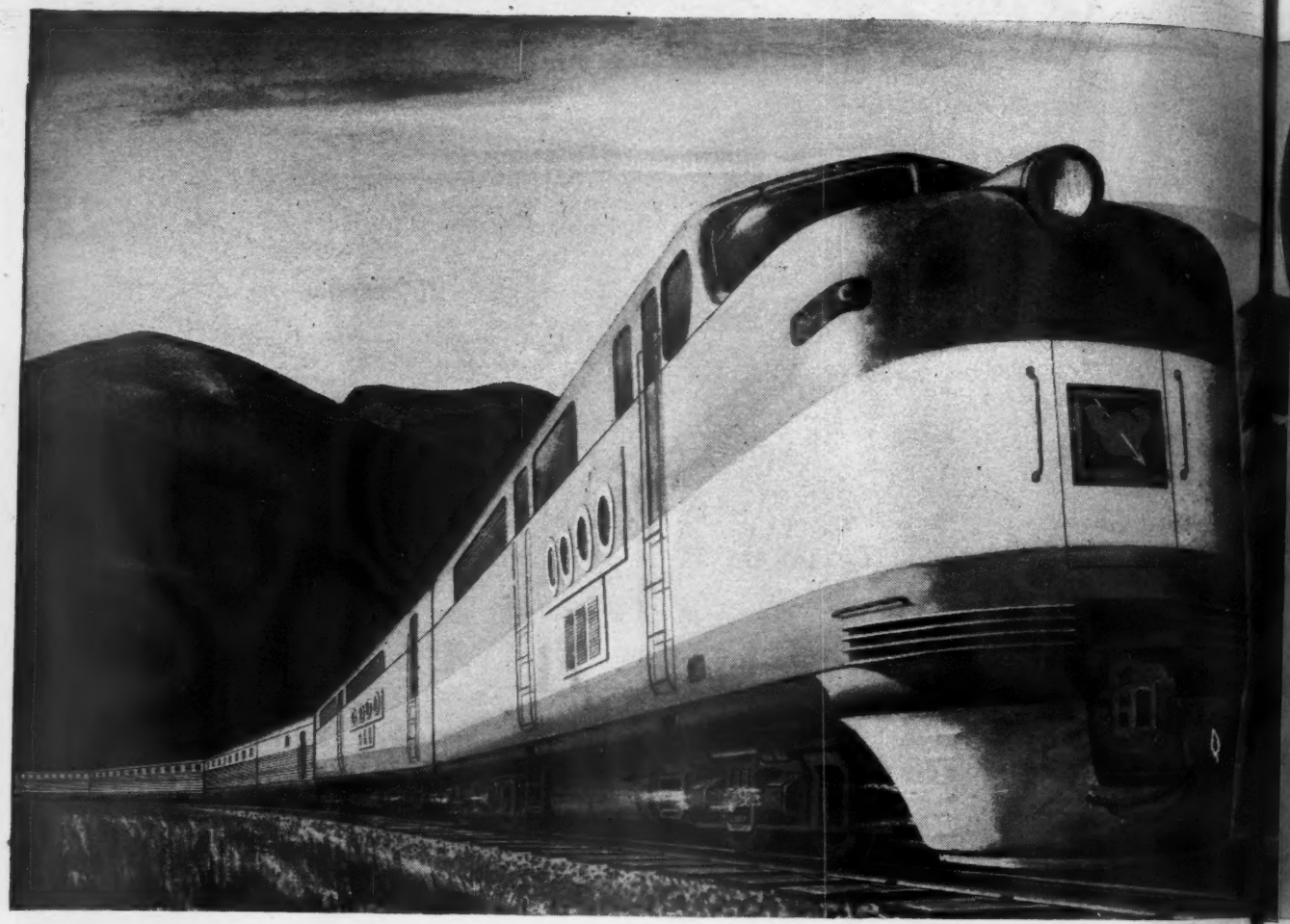
*Registered trademark

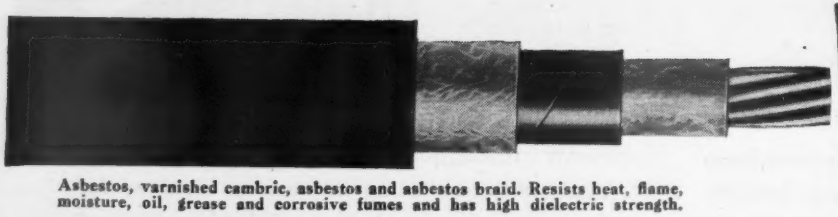
ALCOA

FIRST IN

ALUMINUM

Where *HEAT* is your wiring





Asbestos, varnished cambric, asbestos and asbestos braid. Resists heat, flame, moisture, oil, grease and corrosive fumes and has high dielectric strength.



Typical all-asbestos construction. May be subjected to extreme heat, oil, grease, corrosive fumes.



For electric ranges, furnaces, and other heating appliances.

OTHER U·S·S AMERICAN ELECTRIC WIRE & CABLE PRODUCTS

- New PS Conducting Rubber Shielded Wire and Cable.
- Ampyrol—Synthetic-insulated wire and cable for switchboards and machine tools.
- Amerclad—Tough abrasion resisting cable for portable tools, motor leads, power cable.

U·S·S American Amerbestos Wire & Cable

problem you can depend upon

AMERBESTOS

This asbestos-insulated cable insures long-lived performance under the most severe operating conditions

EXTREME HEAT - FLAME - OIL and GREASE - CORROSIVE FUMES MOISTURE

FOR *tough* jobs, engineers specify a *tough* cable—a cable that packs all-round fine performance. That's why thousands of miles of U·S·S Amerbestos Wire and Cable have been used for installations where unusual and exacting requirements must be met.

U·S·S Amerbestos Cable has proved its ability to solve many difficult wiring problems. It has been used for power and control in our fighting ships, where resistance to torrid heat, moisture, and rotting is needed. Its permanent flexibility recommends it for electric heating appliances and ranges. Its resistance to flame, oil, grease, and corrosive fumes has made it widely used for locomotives and hot locations in power plants.

Amerbestos Wires and Cables of all types are insulated, in whole or in part, with felted asbestos, which is spun around the copper conductor, impregnated with insulating compound, and compressed into an insulating sheath. The covering is firm, flexible, uniform in thickness, and seamless. It will not unravel nor unwind, yet can be stripped easily and cleanly from the conductor.

When more dielectric strength is needed, a layer of varnished cambric and a second layer of asbestos felt are added. Where resistance to moisture, oil, grease, and fumes is necessary, the cable is impregnated with MFH black saturant.

If you need electric wire or cable of any kind—for hot spots, wet locations, high current-carrying capacity, or rough use—get in touch with us. Then you will have the right cable for your specific application.

EVERY SUNDAY EVENING, United States Steel presents *The Theatre Guild on the Air.* American Broadcasting Company coast-to-coast network. Consult your newspaper for time and station.

American Steel & Wire Company

Cleveland, Chicago and New York

Columbia Steel Company, San Francisco, *Pacific Coast Distributors*

United States Steel Export Company, New York

UNITED STATES STEEL

E-B-R CAN HELP YOU...



. . . just as it has helped thousands of other busy electrical men. E-B-R is the *only* annual reference published in, and for, the electrical industry. It is designed with *your* procurement problems on mind—designed to make your work easier, and to save you time and money.

The manufacturers' Briefalog Section is a particularly valuable feature. It includes 527 pages of product data, but due to the unique *Briefalog method of treatment, these pages are equivalent to over 1,500 pages of catalog data handled the old way. You see, the Briefalog was originated by E-B-R. It is the modern way of presenting product data—with essential material all there, but excess "sales talk" or over-long description and detail *left out.*

Please don't monopolize your copy of E-B-R
Show it to other key men in your company, and let them use it, too. Under government paper restrictions, we can distribute only a limited number of copies. You will help us to help you by sharing your E-B-R.

IF IT'S ELECTRICAL, ...LOOK IT UP FIRST IN E-B-R

Now more complete than ever before, your 1945 Electrical Buyers Reference gives you:

MANUFACTURERS BRIEFALOG SECTION—Condensed catalogs of 357 manufacturers. Product specifications, branch offices, warehouses, etc.

CLASSIFIED DIRECTORY—Company addresses and trade names, arranged by product. Extensive cross-reference to help you find the electrical and allied products made by more than 3,500 manufacturers.

INDEX OF TRADE & COMPANY NAMES—Complete with addresses. Starting with only a trade name or a company name, you can thus quickly locate the product data you need.

You'll find it, if you look first in...

ELECTRICAL BUYERS REFERENCE E-B-R

*Briefalog—E-B-R's own original version of modern condensed cataloging.

McGRAW-HILL PUBLISHING COMPANY, 330 WEST 42nd ST., NEW YORK 18, N.Y.

WALKER MAKES A CONTRIBUTION TO ATOMIC POWER



Walker Brothers are glad to have played a part in this gigantic project, which shortened the war and marked a tremendous advance in scientific achievement.

WIRE WITH WALKER

WALKER of Conshohocken

Makers of Rubber-covered, Synthetic and Leaded Wires and Cables * "Weatherhex" Non-metallic Sheathed Cables * Service Entrance Cables * Automotive Wires and Cables * Shipboard Cables — Leaded, Non-Leaded, Synthetic or Varnished Cambric Insulation * Electric Metallic Tubing * "Duralcote" Rigid Steel Conduit * "Preset-Insert" Underfloor Distribution Systems.



Now—MATCH THEIR BEST WITH YOUR MOST IN THE VICTORY LOAN!

Top off your good work on your Payroll Savings Plan with an outstanding showing in the Victory Loan—our last all-out effort!

Help bring our boys back to the homes for which they fought—and give our wounded heroes the best of medical care—by backing the Victory Loan! You know your quota! You also know by past war-loan experience that your personal effort and plant solicitation are required to make your quota.



Sell the New F.D. Roosevelt Memorial $200 Bond through your PAYROLL SAVINGS PLAN!

In rallies, interdepartmental contests, and solicitations, promote the new Franklin Delano Roosevelt Memorial $200 Bond! Better than "cash in hand," Victory Bonds enable the buyers to build for the future—assure a needed nest egg for old age.

Keep on giving YOUR MOST to the Victory Loan! All Bond payroll deductions during November and December will be credited to your quota. Every Victory Bond is a "Thank You" to our battle-weary men overseas—also a definite aid in making their dreams of home come true! Get behind the Victory Loan to promote peacetime prosperity for our returning veterans, your nation, your employees—and your own industry!

The Treasury Department acknowledges with appreciation the publication of this message by

VICTORY LOAN

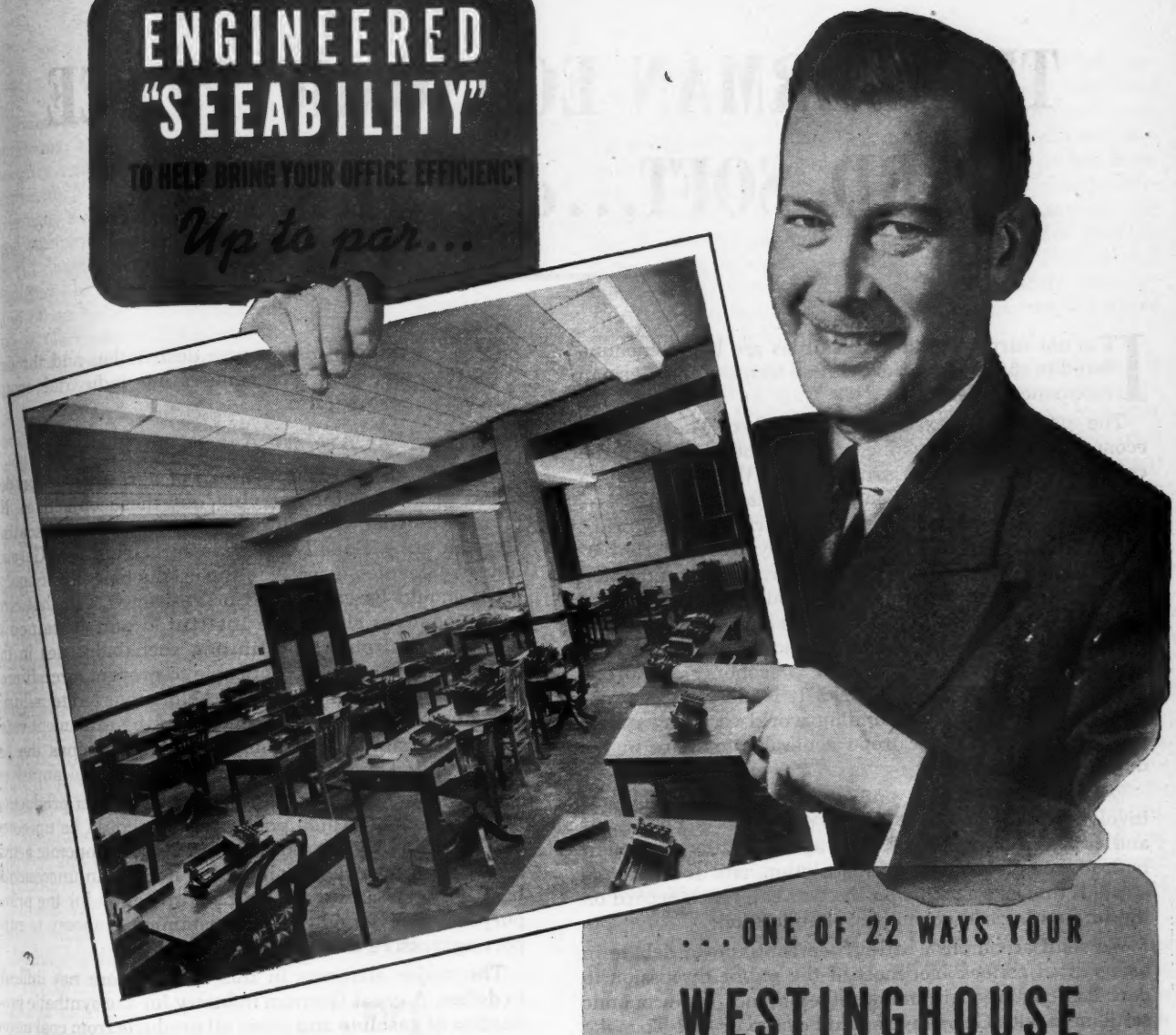
ELECTRICAL CONTRACTING

This is an official U. S. Treasury advertisement prepared under auspices of Treasury Department and War Advertising Council

ENGINEERED "SEEABILITY"

TO HELP BRING YOUR OFFICE EFFICIENCY

Up to par...



...ONE OF 22 WAYS YOUR WESTINGHOUSE DISTRIBUTOR CAN HELP YOU MODERNIZE *Electrically*

Properly engineered "see-ability" for office workers with difficult seeing tasks, is just as important in preventing costly errors and inefficiency as modern shop lighting. And that's just one of the many ways your Westinghouse Distributor can help you modernize electrically to meet the new standards of competition established by these modern plants.

Lighting equipment in a complete range of types and ratings for every office requirement is only part of the facilities your Westinghouse Distributor offers. Most important is the broad background of experience in helping to solve the lighting problems of many other industrial and commercial users. This experience and help, backed by the engineering assistance of Westinghouse lighting engineers, is available to you now.

Check your Westinghouse Distributor for the help he can give you on this and many other electrical modernizing problems . . . today! J-04060



TWENTY-ONE OTHER WAYS your Westinghouse Distributor can help you in planning electrical modernization, whether for a single department or your entire plant, are suggested in this new book. It provides a valuable check list on modern electrical practices . . . from incoming power to methods of utilization and control. Ask your Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa.

Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

THE GERMAN ECONOMIC PEACE HARD, SOFT... or WORKABLE?

IT is not surprising that difficulties are being encountered in spelling out the detailed terms of the German economic settlement.

The problem is exceedingly complex. The German economy is more or less inextricably bound up with the economy of continental Europe. Before the war that area—excluding the United Kingdom, Ireland and Russia—accounted for approximately one-fourth of the world's production, and for more than thirty-five per cent of world import and export trade. Germany's production constituted almost one-third of the output of continental Europe. It is obvious that the decisions we make now concerning the future German economy will exert profound influence not only upon the economy of Europe but also upon that of the world. It is clearly not practicable to plan for an expanding world economy unless provision is made for Europe generally to share in the development.

Despite the magnitude and complexity of the problems involved, it is crucial that we and our Allies come to swift and decisive agreement. Such agreement is important both to world economic reconstruction, and as a demonstration that those who won the war can reach accord on the terms of world economic rehabilitation.

We shall accomplish little if we continue to debate in terms of *adjectives*. Yet most of the public discussion to date has centered around whether or not the economic settlement with Germany should be *hard* or *soft*. To make progress we must focus instead upon *objectives*. A good program is one that will promote our objectives—a bad program is one that will not.

What Are We Trying To Accomplish?

Upon the economic objectives of the German peace settlement there is little fundamental debate. This is demonstrated by reference to a number of documents of recent release—the United States Directive to General Eisenhower of April 1945, the Report of the Tripartite Conference at Berlin of July, the Report of the American Advisors to the Office of Military Government of September. The latter document stresses fundamental difficulties in developing a practical program for carrying out the objectives of the other two, but it does not question their formulation of aims.

What are the objectives that we are seeking to forward:

1. The disarmament of Germany.

2. The elimination of German industries devoted primarily to armament production.

3. The assessment of reparations to compensate those nations which have suffered losses from German aggression through direct war destruction and through the German policy of confiscating industrial equipment to her own use.

How Far Are We Agreed on Procedure?

There is also a wide measure of agreement upon detailed procedure for carrying out these objectives. No one, of course, questions the policy of confiscating German arms. Equally, there is agreement that German industry devoted directly to the production of war equipment should be confiscated or destroyed, and that control measures should be instituted and sustained to prevent her from reconstituting such industries in the future. Since it is not practicable to prevent aircraft production and shipbuilding from being diverted to military use, these industries are included in the armament category. And similar reasoning generally extends the list of prohibited industries to ball bearings and abrasives.

There is an additional category of German production which all of the Allied powers agree should be uprooted and permanently barred. It embraces all economic activity which prewar Germany cultivated on an uneconomic basis through subsidy and other protection for the prime purpose of developing a self-sustaining economy to support aggressive war.

The major elements in this category are not difficult to define. A great German industry for the synthetic production of gasoline and other oil products from coal never operated upon an economic basis. The cost of such fuel products to prewar Germany averaged almost four times what it would have cost her to buy petroleum products in the world market. It is doubtful whether these plants could be operated postwar at a cost much below three times the world market price for competing petroleum products.

A similar situation applies to German synthetic rubber production. In an attempt to free herself at least partially from dependence upon supply lines, she produced synthetic rubber at a cost at least double the world market purchase price. Similarly, she protected or otherwise subsidized a considerable agricultural production, particularly in grains, for which her lands were so ill suited that Germans had to pay for German-grown wheat from three to four times the world market price.

These are merely outstanding examples. The maintenance of such activities in Germany constituted a drain upon the German economy rather than an advantage other than that of preserving a self-sufficiency necessary for war. Hence their elimination is clearly indicated, and generally subscribed to, though the job of defining a complete list is far from easy.

What Is The Area of Dispute?

Unfortunately, this total catalogue of agreed-upon measures is not sufficient to provide either adequate security against a resurgence of German militarism or satisfactory restitution to her European neighbors for Germany's ruthless destruction of their industrial plant and equipment. To serve these two ends it is necessary to cut down the margin of German dominance in heavy industry—in steel, in electric power, in machine tools, and other industrial equipment. Unless such steps are taken, Germany will emerge from the war with sufficient industrial power to provide a continuing and perhaps uncontrollable military threat; and we should be perpetuating a dominance that was developed, as a matter of German strategy, far beyond the requirements of her civilian domestic markets or the export potentials of normal trade.

German steel capacity was built to a wartime peak of twenty-four million tons a year. Before the war she had accumulated a store of machine tools greater than that of the United States, and her present stock of some four or five million tons of such tools is second only to ours. There is little debate over the necessity and justice of cutting down the margin of German dominance in heavy industry, particularly since it was built to its current levels through aggressive economic warfare to serve as an instrument of actual warfare. It is recognized, too, that in this sector of the German economy will be found the most useful reparations in kind for the countries damaged by German aggression.

The question is how much heavy industry and electric power equipment should be taken from Germany and transferred to others. The Russians, having experienced colossal war damage, are demanding very severe assessments. They talk of reducing postwar German steel capacity to three million tons annually.

The United States inclines to assessments in this field of less extreme dimension—we have suggested leaving in Germany an annual steel capacity of from seven to ten million tons. We naturally are concerned lest action be taken that will cause a complete breakdown of the German economy. If this should happen while we maintain occupational forces there, we should feel responsible for seeing that the Germans within our jurisdiction are provided with at least the means for subsistence. Furthermore, both we and the British know that in the long run our peoples will not support control measures over Germany which go beyond our concepts of reasonable fairness consistent with security requirements.

It is no part of our intention, as has been suggested by some, to provide for a German economy that will serve as a buffer against Russian expansion. We know, however, that our weakest course would be to commit ourselves now to continuing control measures which our people would later repudiate as falling outside democratic concepts of justice. On this issue we cannot, and should not, compromise.

How Can We Resolve Our Differences?

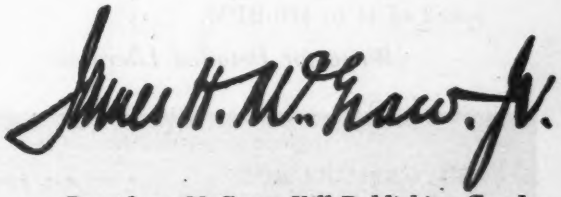
The best chance for resolving the differences which have appeared between the Russian position on the one hand and the American and the British position on the other lies in making a sharper distinction than has appeared in current discussion between long-term and short-term control decisions. All of us are agreed upon the policy of wiping out German military production and that part of German economic activity which has been run at economic loss to provide for a national self-sufficiency useful only for war purposes. But we are unwilling to enter into long-term commitments for holding down those parts of the German economy that do not constitute a war threat. That would unduly penalize future generations of Germans and drag down the whole economy of continental Europe.

It should be possible to reach agreement that measures for cutting down German heavy industries and power-generating facilities are immediate measures, and that no attempt will be made to sustain such controls over an extended period. If part of the German establishment in these fields is transferred to countries whose manufacturing resources have been damaged by German aggression, it can serve the purpose of effecting a reasonable balance without destroying utterly incentives for a new generation of Germans to improve by peaceful methods their status in a peacetime world.

Such a program is consistent with the concept of building a healthy and balanced European economy in which general economic interdependence provides one of the essential safeguards against a resurgence of German militarism. We must still face the problem of agreeing upon how far the non-armament segments of German industry can be cut back at the present juncture without leading to disastrous breakdown with its resultant chaos. Such definition, though formidably difficult, should not be beyond the capacities of the nations whose combined might brought victory, and who have the strongest of incentives for devising a lasting peace.

The key to agreement lies in each of us doing his best to understand the position of the other. Russia must recognize that we cannot get our people to subscribe to the permanent repression of a European economy which would deny to millions of people any hope of normal economic betterment. We should try to understand Russia's conviction that she is entitled immediately to reimburse herself for her war losses by drawing upon the German industrial establishment that still exists. It will help to resolve our differences if we separate in our thinking steps that require permanent controls from those which are merely temporary expedients.

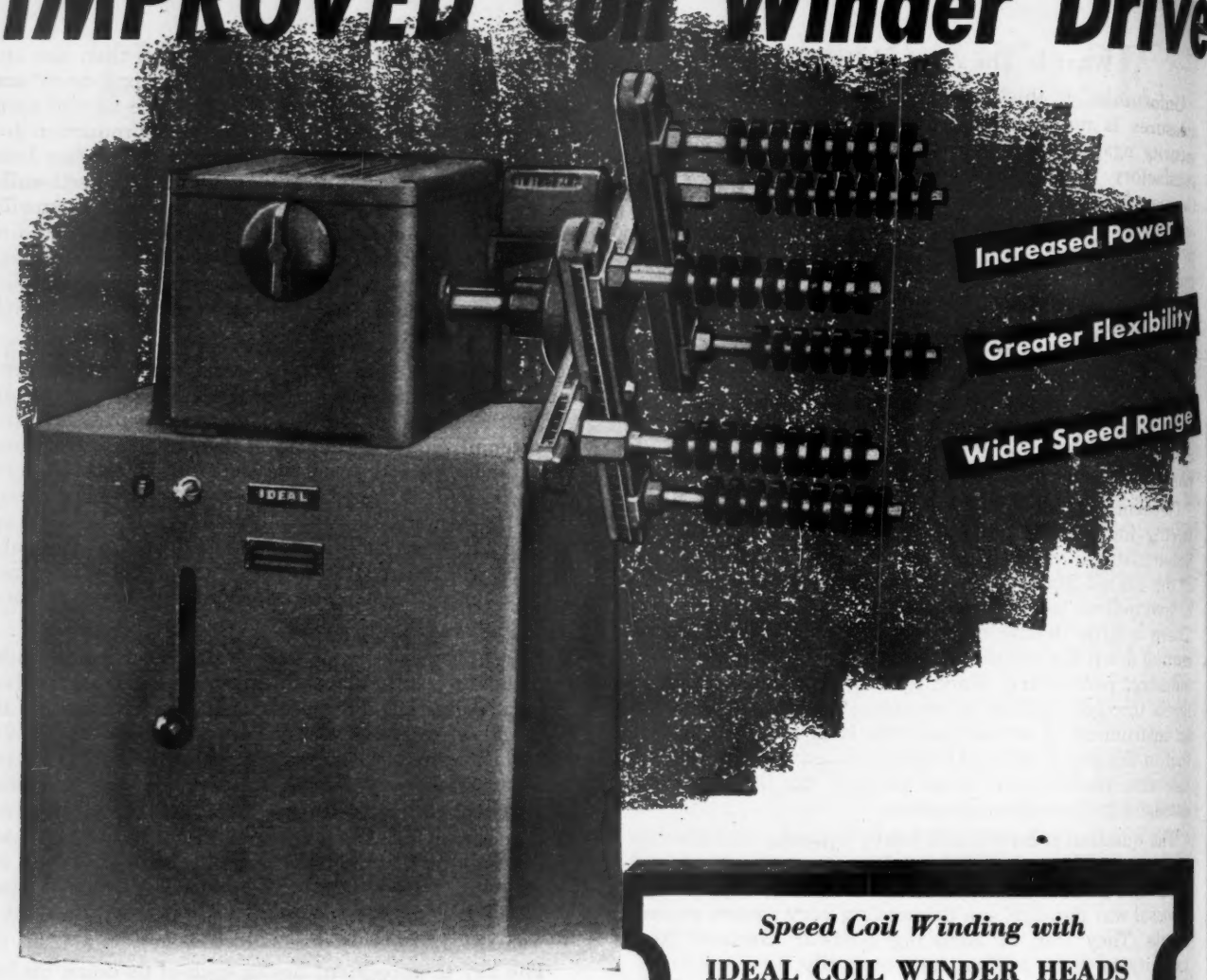
Neither of us will be forwarding our ultimate and common objectives if we impose controls that blight the development of so large and important a segment of the world as continental Europe. In such a blight lies the germ of a Third World War.



President, McGraw-Hill Publishing Co., Inc.

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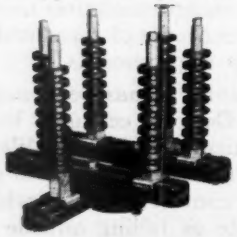
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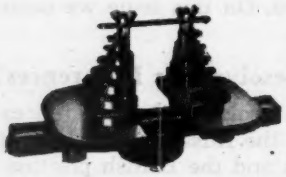
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NOVEMBER . . . . at a Glance

Section meetings of the IAEI around the country in recent weeks have been exploring in some detail the actions of the Electrical Committee on the new Code. Reports by Bill Cyr on the West coast meetings and Gus Eckel on the Western Section in the news this month give a quick picture of the current discussions. The great mass of detail which had to be considered by the Committee in this revision is still to be weighed and measured, however. We'll have a complete and authoritative story just as soon as it can be brought together. The consensus right now is that the new Code will not be out before October 1946. Some insiders claim, however, that the machinery may move much faster.

★

Our cover picture this month is the electrical maintenance shop at the General Motors office building in Detroit. Well-ordered benches, ample working space, convenient tool storage, flexible power outlets, good lighting and good housekeeping were all plainly evident. It is a good example of modern maintenance practice.

★

We have long contended that the only place where accurate and sound estimating data is most valuable is in the hands of your competitors. Sound experience data, generally available, means good bidding and good business. Chicago electrical estimators have been sharing their estimating know-how for many years. They are enthusiastic about their work. They have contributed much to good estimating methods and accurate predictions of job costs. The story of this organization is told on page 47.

★

Ray Ashley, Research Engineer of Chicago, continues his series of articles on preliminary estimates in this issue. He takes up a discussion of development and application of tables of units including units for service, conduit and wire circuits. This material is especially timely during the current preparation of construction plans in every city. Mark this as a "must" item for all of your associates concerned with current quotations. You will find the story "How Much It Will Cost" on page 52.

★

Show windows are brightening up as fast as lighting equipment and labor supply becomes available. Berlon Cooper's series on modern lighting techniques this month develops the principles of good show window lighting methods. The impact of fluorescent lighting on show window techniques has radically changed previous conventional practices. Here is up-to-date information. You will find the story on page 60.

★

High intensity fluorescent lighting installations has raised a great number of maintenance problems coincident with the great increase in the number of lamps and circuit complications. Harris Reinhardt's "How To Check Fluorescent Components", page 49, gives practical hints for testing fluorescent lamp starters and ballasts. The test boards described and the test kits recommended offer a number of practical ideas that men concerned with fluorescent lighting maintenance will find useful and valuable.

★

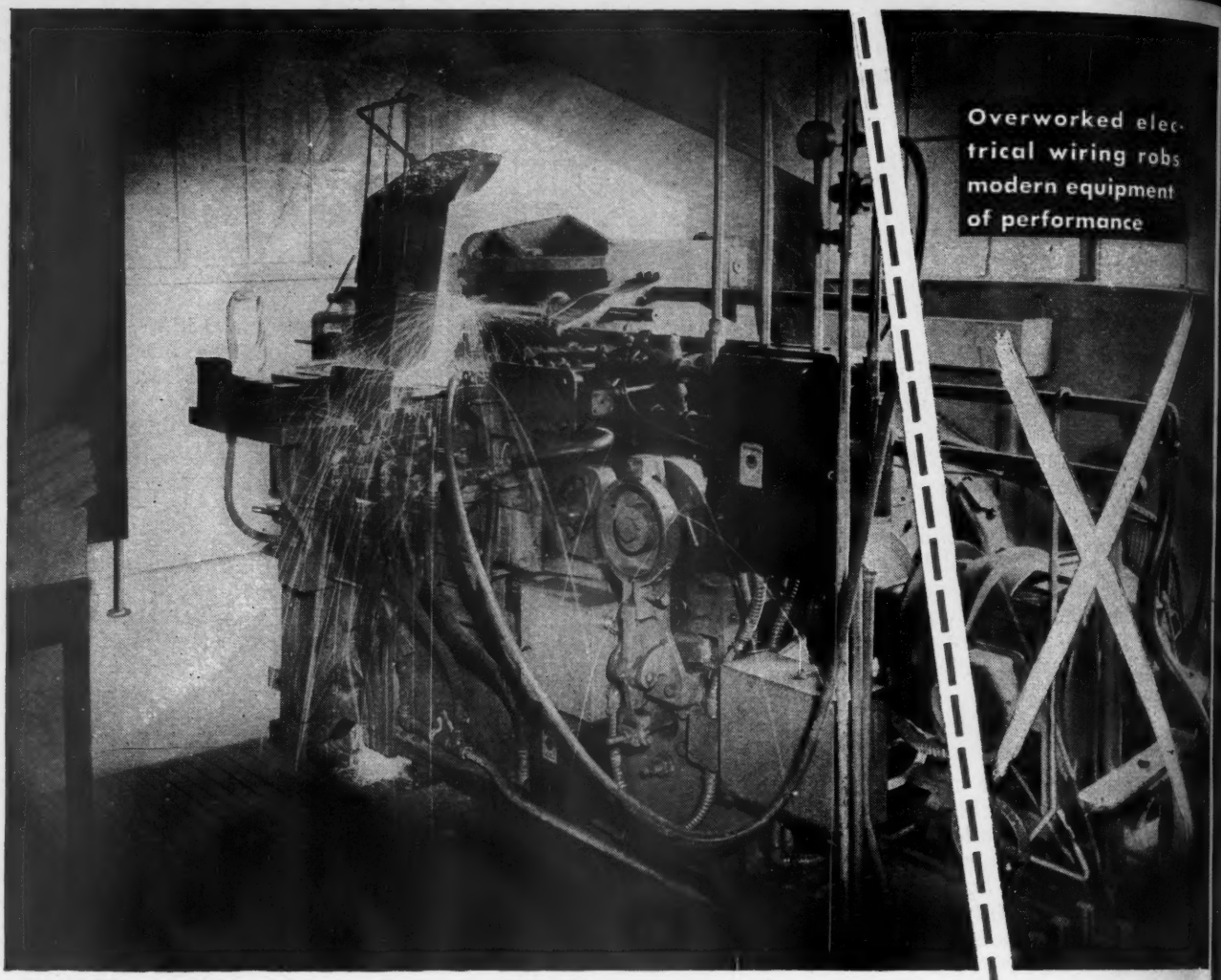
The use of flammable liquids, gases, paint sprays and other hazardous materials in industry during the last few years has been greatly on the increase. There has been a parallel increase in electrical equipment to suit the needs of such locations. A thorough-going analysis of what makes electrical equipment safe for use in hazardous locations is presented in J. A. Trovillo's article on page 66. Here is real insight into the research and testing techniques that back up equipment labelled for use in hazardous locations.

★

Silicone insulations permit the operation of motors in temperature ranges which would heretofore have caused frequent failures and expensive equipment rebuilding. Consequently, motor windings insulated with fibre glass and impregnated with silicone varnishes have been the solution of many vexing industrial motor problems. Walter Ruppprecht, Superintendent of the Electrical Department of Dow Chemical, describes, in an article on page 58, how his department uses the new silicones.

★

Watch for a complete report on the NECA annual meeting next month. A program of distinguished leaders in government and industry plus discussions on many pressing industry problems will make this one of the most important meetings in industry history.



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MARKETS FOR SPACE HEAT

At least one large electrical manufacturer will soon break a campaign to develop electric space heating in the West. Other areas—where moderate seasonal degree day requirements, low rates and energy surpluses prevail—also offer a ready market for a phase of electrical development which has had altogether too little attention.

On a straight prime fuel to kilowatt hour cost comparisons, a rate of about four mils would be necessary to obtain an even break with coal or fuel oil. The fallacy in such comparisons, however, is considering electricity a "fuel." It isn't. It is highly refined energy. It is readily portable. It is quickly and cheaply adaptable to any heating job. It is easily and accurately controlled. It requires little maintenance and no supervision.

Thus, a true consideration of the costs of electric heat must take into account factors other than "fuel" and "heating plant." In industrial operations, for instance, many applications of infra-red radiant heat have proved that energy cost can be an almost insignificant factor when compared with improvements in production that the flexibility, convenience and accurate control of electric heat made possible.

One of the most important advantages of electrical heating is that it needs no heating plant. Maximum benefits in terms of cost as well as other considerations come with structural designs and facilities which take this factor into account. The use of manufactured gas as a heating fuel gained wide acceptance when developments in insulation brought cost down. Equipment savings would, of course, be obtained with any fuel. But the public is always more interested in new comforts and conveniences in preference to simple economies. Modern insulation methods allowed these modern benefits at a premium price which people were quite willing to pay.

With the heating plant eliminated and the space usually occupied devoted to productive or revenue-producing uses, with accurate control and minimum maintenance, electric heating may easily command a substantial premium. How much will have to be determined by experience. But with all fuel costs headed steeply upward, while electric rates continue down, the competitive position of electric heat may be better than we know.

Electric heat is potentially a great market for every segment of the industry. A broad expansion in electric heating application would revolutionize our present concepts of wiring systems. It would add millions of dollars to the market for the contractors' services. It would open new areas of activity for the manufacturer and the utility. It would bring great public benefit, safety, comfort, convenience and health.

And as with every other end product of electrical development, the electrical contractor and industrial electrical man will have to take over a large share of the market development. The systems he installs and maintains can substantially enhance or retard progress by the effectiveness with which they meet the customers' real needs.

Wm. F. Stuart

Electrical Contracting

NOVEMBER, 1945

WIRES *and* CABLES



No matter what conductors you need to complete your contracts, you'll find it pays to let Graybar supply them. Graybar stocks hundreds of types and sizes of wire and cable — insulated and armored — for ordinary and special jobs. Delivery from a local Graybar warehouse saves time.

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4592



IN OVER 80 PRINCIPAL CITIES



Chicago estimators confer on unit costs at September meeting.

THESE ESTIMATORS Share Experience

Chicago electrical estimators have contributed much to sound estimating methods and accurate costing through study and sharing of experience data.

BACK in 1916, three men sat huddled around a table in the far corner of a Chicago restaurant. Above the cracking of reference papers and notes came the din of animated discussion, hectic at times. They were desperately trying to discover why their individual electrical estimates were so far apart; to find some logical explanation for the job in question being taken at such a low price.

Finally they left, conceding the meeting a failure because lack of uniformity of estimates prevented a comprehensive check. The three could not agree on many items of cost. All might have ended there. But the curiosity and determination of these three estimators to do something about a chaotic situation led to the formation of an organization whose members probably did more than any other individual or group of individuals to establish estimating as a systematized and scientific branch of the electrical contracting industry.

Similar meetings followed this first one. These were held, not for the purpose of checking any particular electrical project, but rather to establish sound and uniform methods of estimating. Other estimators were invited to join the group. In a short time a movement got under way to form a permanent association.

It would have been too much to hope that such an organization could get started without a great deal of opposition and adverse criticism. To many, it seemed like a scheme to get contractors to place their most valuable information and trade secrets at the disposal of their competitors. Strange as it may seem, contractors who had the least to offer made the greatest fuss. Some dubbed the movement as an "outrage and a curse to the industry."

Other contractors hailed the movement as laudable and encouraged their estimators to support it. They even attended some of the meetings themselves to help get things started.

Some estimators hesitated to join for fear that it would jeopardize their chances of holding a position. One of the leading proponents of the association always advised such wary prospects, "Join our organization and learn how to estimate properly. Then, if you lose your job we shall get you a

better one." No man ever lost his job because of affiliation with the Estimators' Association. Many admit that they gained much from their membership.

Despite the struggles against early opposition of this type, the association grew stronger and most contractors now attest to the value of such a research and educational project.

Cooperative Program

Although there is no formal connection between the Electrical Contractors' Association of City of Chicago and the Chicago Electrical Estimators' Association, the two groups work together. Walter Collins, secretary of the Contractors' Association, opens his office for night meetings of special committees and his secretary handles the sale of estimating forms and sends out meeting notices. The estimators, in turn, have a special committee to aid the contractors in their research on operating and equipment costs. The findings of this research were presented in a paper entitled "Neglected Costs" presented at the 1939 NECA Convention in Philadelphia. Again in 1940 an estimators committee was appointed to check the tables of "Comparative Costs" used at the Jacksonville convention.

The early days of the association were crowded and strenuous. The membership was small and everyone was on a cost data committee. The complete membership met once a week and some committees met twice a week with sessions lasting from four to five hours. There were a lot of manhours spent on the original tables. The ten years prior to 1917 has witnessed radical and rapid changes in the demands for electrical contracting services. The estimators were not at all satisfied with their own cost data and much less receptive to accepting proposed units presented by others.

Considerable time was consumed in deciding how tables should be set up and what units should be used. Before outlet box units could be estimated, it was necessary to decide whether the measuring and cutting of conduit should be charged against the outlet box or the conduit. Again, there was the question of poling up. Should this be charged against the wire or the outlet? And so it went with every table. There always were questions as to the proper distributions of labor—many of them so long settled that now they seem rather simple. However, they represented a real problem at that time.

Out of many discussions evolved the "conduit weight rule," "panel rule," and other methods which serve as excellent guides for establishing tables of labor cost units from experience data.

The founders never let their anxiety to get started prevent careful deliberation on membership personnel. To meet the qualifications then—as at present—a man had to be:

1. A capable estimator engaged in estimating electrical construction work.
2. Willing to work diligently on committees.
3. Willing to attend meeting regularly and take an active part in the programs.

Naturally, such a policy limits the possible membership. Today there are 33 estimators on the association roster and the minimum during the past 20 years has been 23.

Approximately 60 percent of the members are engineering graduates from outstanding universities. Some of these men worked with the tools to earn money to go to school and so have had experience in actual electrical construction work. The rest came up through the ranks and obtained their technical training by attending night schools and studying on the side while they carried on their regular work. Such a combination of members is ideal for an electrical estimators' association.

Contributions to the Industry

The association's first important contribution to the contracting industry was at the NECA Convention in Cleveland in 1918. Many contractors secured their first real insight into methods of establishing labor costs at that meeting. Some of them are still enjoying the benefits. Subsequently, data and tables of cost units worked up by the Chicago estimators were distributed throughout the country in many ways. There were, for a few years, associate members in other cities who received copies of all publications. From time to time, out-of-town visitors were given sets of tables. Members of the Association who moved to other cities took their data with them. Some of this information got into the hands of very capable estimators, in other cities, who used it to augment the research work which they were already carrying on. So, in various ways, the work of the Chicago Electrical Estimators' Association found its way into the hands of electrical contractors in all parts of the country. Undoubtedly it has served as a fairly universal guide for formulating labor cost tables and contributed significantly toward stabilizing estimating.

A detailed account of just what the various committees do and how the work of the Chicago Electrical Estimators' Association is carried on might be interesting. Space restrictions, however, preclude elaboration. A general idea of the association activities can be gleaned from the following list of accomplishments during the past two years:

1. Revision and expansion of the panelboard and switchboard section of the data book.
2. Revisions and additions to the wire pulling section of the data book.
3. Comprehensive review of the Interim Amendments to the 1940 National Electrical Code.
4. Work in conjunction with the Electrical Contractors' Association of City of Chicago on the development of preliminary estimating units for various branches of an electrical installation.

When written down, this doesn't look like much, but it represents a great deal of work on the part of the various committees. Besides this work, many reports have been given on special jobs by members. From these reports on costs, methods of construction, etc., the members were able to gather many notes for future reference.

Here are some of the items listed on the agenda of future meetings:

1. Readjustment of operating costs to fit postwar conditions.
2. Discussions of new tools available and their value.
3. Overcoming difficulties and excessive cost of wire pulling.
4. Revision of existing units and development of new labor data.

Before this schedule is completed there will be many other subjects added to the agenda for future discussion. For, today, the electrical contracting industry is again facing the necessity of making numerous readjustments in estimating factors and construction techniques based on experience gained during the war construction period. Keeping abreast of postwar conditions will add other topics to the list.

It does not seem the least presumptuous to say that if the contractors had accomplished or would accomplish half as much to promote sane bidding as these estimators have to promote sane estimating, the industry would enjoy a much healthier future.

How to Check FLUORESCENT COMPONENTS

Practical circuits for checking fluorescent lamps, starters, and ballasts, with ideas to use in designing test boards and kits to meet particular needs.

By Harris Reinhardt
Commercial Engineering Department
Sylvania Electric Products Inc.

BY FAR THE greater percentage of cases of trouble of fluorescent components which are encountered involve a lamp which fails to light and can be reduced to a simple problem of determining whether it is the lamp, ballast, or starter that is at fault. A simple routine of checking the lamps and starter in a fixture or test circuit which is known to be operating satisfactorily will usually be found entirely adequate. In some instances it will be found that a short-circuited starter or a dummy starter, with leads from the contacts brought out to a snap switch to constitute a manual starter, are helpful in this problem of locating the faulty element by a process of elimination. A simplified procedure for checking a fluorescent lamp circuit in this manner is outlined in Table 1. Electricians who have used this procedure over a period of several years report that it is entirely adequate in all but a few exceptional cases.

Thus, the maintenance man on the job usually does not need any elaborate test equipment, for once he has determined whether it is the lamp, starter, or ballast which is the cause of the trouble, his problem resolves itself into one of replacing the faulty element. Many electricians have found it helpful, however, to have in their shops a lamp board where they can check lamps and starters to see that they operate properly. A number of circuits for equipment of this type are illustrated in the accompanying diagrams and described below.

Lamp and Starter Test Boards

A light-up board for checking lamps and starters may be a simple arrangement, as shown in Fig. 1, for lighting lamps of a single size, or it may combine several circuits to provide a means of lighting lamps of several different sizes, Fig. 2. If desired, a fluorescent lamp socket in series with a socket containing an incandescent lamp bulb can

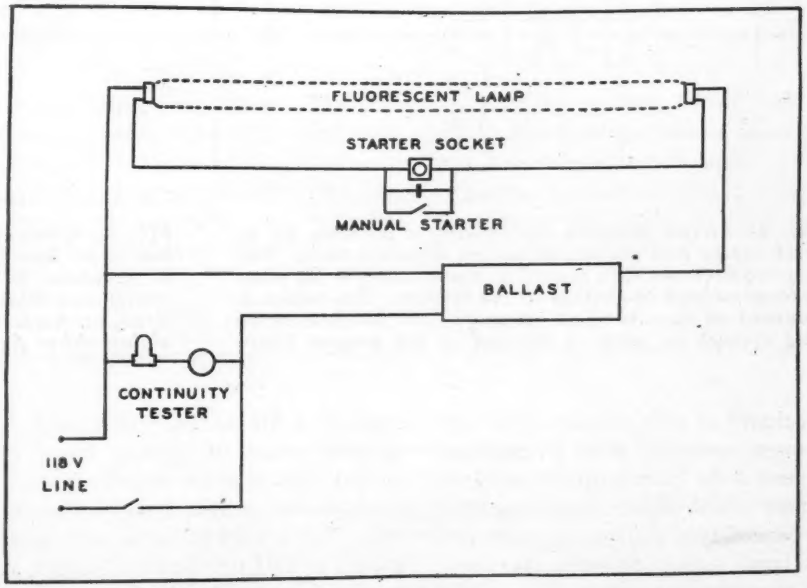


FIG. 1—Simplified board designed for checking lamps of one size only illustrates the fundamental circuits which can be included in any board. In checking a lamp an automatic starter may be inserted in the starter socket, or the manual starter may be used. It is suggested that a small condenser such as is included in the stardard starter can be connected across the manual starter contacts as shown in the diagram. In checking a starter the lamp may first be lighted with the manual starter to make sure that it can be lighted. The lamp can then be turned off by opening the line switch, the starter to be checked inserted in the starter socket and the line switch turned on again to see if the starter will light the lamp. In using the Filament Continuity Tester, each end of the fluorescent lamp is tested in turn. The end to be tested is inserted in the fluorescent lamp socket. If the incandescent lamp fails to light it indicates that the filament type electrode in the fluorescent lamp is broken. Any 115-volt light bulb of the 25-watt size or smaller may be used for this test. A continuity tester of this type can be incorporated in any of the other circuits shown in this article if desired.

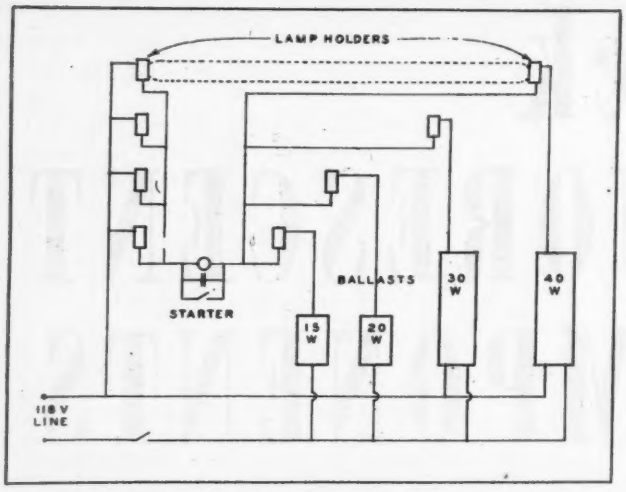


FIG. 2—Board made up for checking lamps of several different sizes. It is simply an elaboration of the board shown in Fig. 1. In using this board all of the lamps except the one under test must be removed from the board. This limitation can be overcome, if desired, by providing a separate starter socket for each lamp.

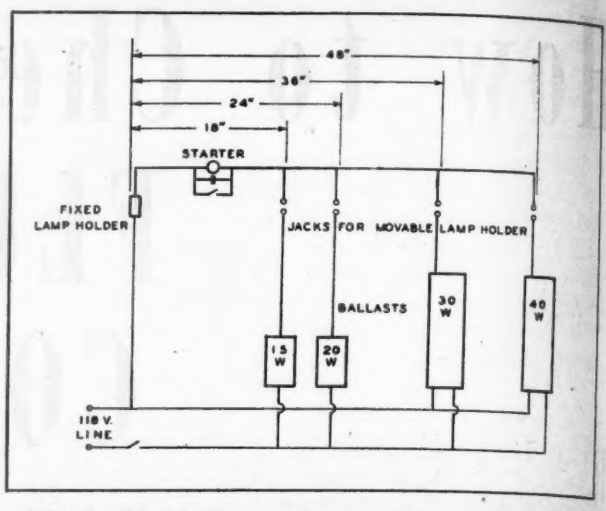


FIG. 3—Circuit diagram for a compact arrangement to check lamps of several different sizes. One of the lampholders is mounted in a fixed position, and the other is provided with banana pins, and may be plugged into any of the several pairs of jacks shown. These jacks are spaced to accommodate lamps of different sizes.

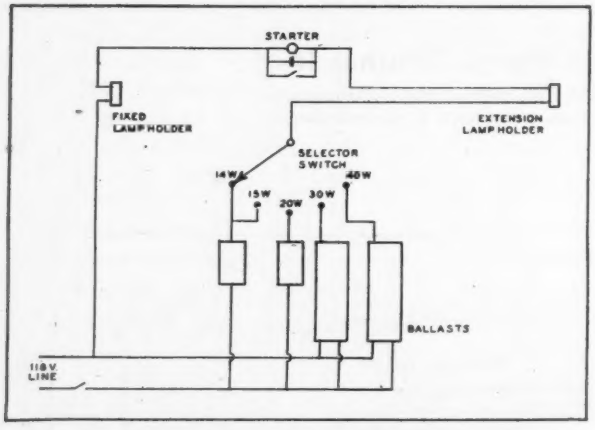


FIG. 4—Circuit diagram for making a portable kit to check lamps and starters of several different sizes. The only requirement with regard to size is that the kit must be large enough to contain all the ballasts. One socket is mounted on the end of an extension cord which must be long enough to reach to the end of the longest lamp.

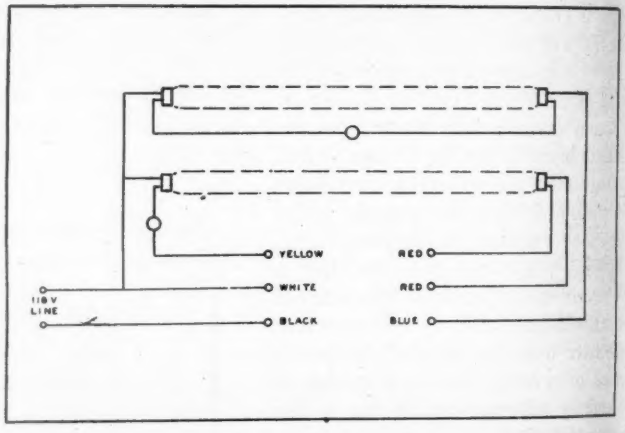


FIG. 5—Convenient means of quickly connecting a ballast into a fluorescent lamp circuit. When a good ballast is connected in place it also can serve as a lamp and starter test board. This idea can be elaborated, if desired, to check ballasts of several different sizes by providing either fixed or movable sockets to receive lamps.

be included on such a board to provide a filament continuity tester for checking each end of the lamp in turn to see if the filament is still intact. Lamp boards of this general type also may be made with one lamp socket mounted stationery and the other provided with pins so that it can be plugged into the jacks located at the proper distance for taking lamps of various lengths, Fig. 3. With this arrangement, connections are automatically made to the proper ballast when the socket is plugged in at the proper distance to receive the lamp. The circuit diagram shown in Fig. 3 is for a lamp board designed to receive lamps varying in size from 15 watts to 40 watts. The same idea, of course, can be extended to lamps of other sizes.

In Fig. 4 is shown the circuit diagram of a kit designed to provide a portable means of lighting lamps of several sizes in order to make it possible to check lamps and starters on the job. The kit needs to be only large enough to hold the required ballasts, as connection to one end of the lamp is made by means of a lampholder on the end of an extension cord. Kits of this type were available commercially before the war, and may soon be appearing on the market again.

Ballast Test Boards

An arrangement for quickly wiring a ballast into the circuit and checking to see if lamps will start and operate from it also will be found useful in the electrical maintenance shop from time to time in checking ballasts before they are installed in fixtures. The wiring diagrams for a board of this type for checking 40-watt two-lamp ballasts for 110–125 volt service is shown in Fig. 5. This is simply a two-lamp circuit with binding posts left at the points where the ballast must be connected in order that quick connections may be made. By providing socket spacings necessary to receive lamps of other sizes, such a test board can be used to check ballasts of any size, provided care is taken to make the connections through the proper binding posts. To facilitate tracing the connections, surface wiring may be used, or lines showing the connections may be painted on the face of the board.

When a ballast has been found to be faulty it may be of interest and value

to check to find the cause of the failure. For this purpose a continuity checker employing ordinary incandescent lamps and operated from a 110–125 volt convenience outlet may be used. The circuit diagram of a tester of this type is shown in Fig. 6. Sockets are provided for two lamp bulbs, one of which is used to check continuity and the other to check for a shorted condenser. The two lamp sockets and the switch can be mounted in a small box, if desired.

In making tests of this type it is always helpful to have a circuit diagram of the internal connections in the ballast in order that the leads, between which there should be continuity, can be traced. A diagram of this type for a ballast used to operate two 40-watt lamps on 110–125 volt circuits is shown in Fig. 7. The use of these test circuits will be described with specific reference to a ballast of this type in order to illustrate the general procedure which may be followed with a ballast of any particular type.

It should be noted that when the unit is plugged in, the two test lead wires are "hot" and they should be handled accordingly. For this reason it is recommended that an insulated alligator clip or insulated battery clip be provided for one lead, so that only one of the leads needs to be held in the hand during the testing procedure.

(a) *Condenser Test*—For this test the switch is thrown to position No. 2. A 40-watt incandescent light bulb is used to check ballasts for 40-watt fluorescent lamps and a 100-watt incandescent light bulb to check ballasts for 100-watt fluorescent lamps. The test probes are connected to the outside blue and outside red leads of the ballast. It can be seen from the diagram that this places the choke coil in series with the choke plus condenser combination. If the condenser is okay, it will tend to balance the choking effect of the choke coils and the lamp will light to full brilliancy. If the condenser is shorted, however, the two choke coils will limit

[Continued on page 179]

TABLE 1

HOW TO CHECK A FLUORESCENT FIXTURE WHEN A LAMP FAILS TO LIGHT

The importance of making sure that proper connections have been made to the line and that voltage is available at the fixture goes practically without saying. If these have been checked but the lamp fails to light, the following procedure may be followed to locate the cause of the trouble:

CHECK THE LAMP. Make sure that the lamp is not defective by checking it in a fixture which is known to be operating properly, or replace it with a lamp which has been checked and is known to be good.

CHECK THE STARTER. If the lamp which is known to be good will not light in the fixture, remove the starter from the fixture and replace it with a starter which has been checked and is known to be good. If the lamp will not light with this starter it indicates that something is wrong with the wiring or the ballast.

Another way to check the starter is to use a short circuited starter or "dummy" starter with leads from the terminals brought out to a snap switch. When a short circuited starter is in the fixture there should be a fluorescent glow from each end of the lamp, as during the preheating or starting period. If this occurs it is a reasonably good indication that the circuit is properly connected. If it is possible to start the lamp by quickly removing the shorted starter, it indicates that the original starter was the cause of the trouble.

CHECK FOR POOR CONTACT IN THE LAMP SOCKET. With the short circuited starter in the starter socket, twist the lamp gently in the lampholders to see if contact can be made. The connections of the lead wires at the lamp sockets should be checked to make sure they are tight. If a combination lampholder and starter socket is used the connection between the two should be checked to make sure that good contact is being made.

CHECK THE WIRING AND BALLAST. If a check on all of the above does not disclose the defective part, the entire wiring of the fixtures should be checked. If this is not defective then it may be assumed that the cause of the trouble is in the ballast, and it will have to be replaced. A continuity check for open circuits, short circuits, or grounds in the ballast, to determine the exact nature of the defect may be made, if desired.

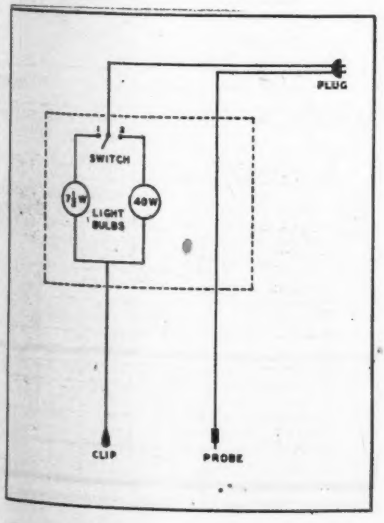


FIG. 6—One of many arrangements which may be used for checking a fluorescent lamp ballast for continuity. The 40-watt bulb checks condensers.

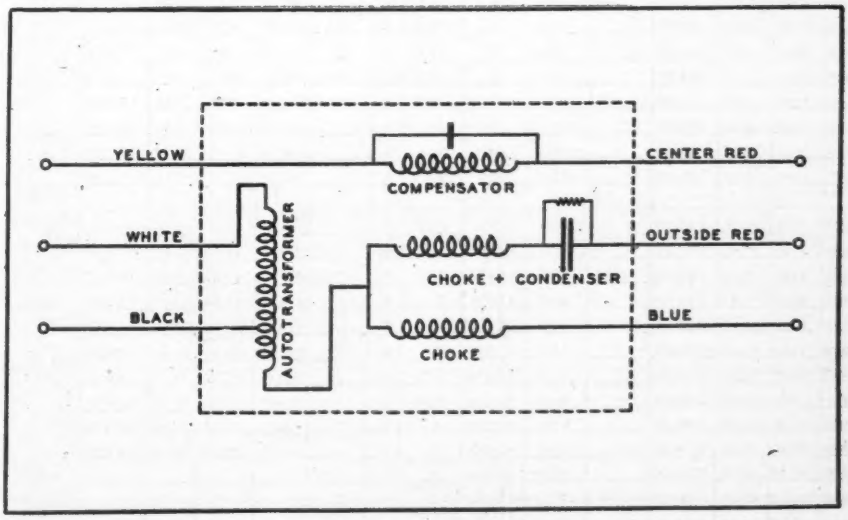


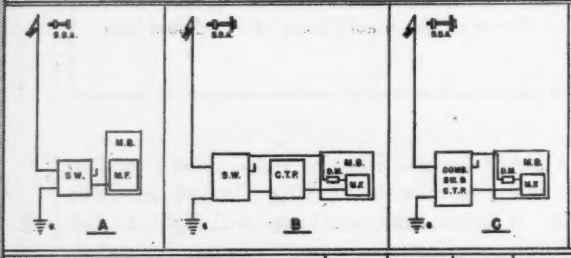
FIG. 7—Checking for continuity, shorts, and ground by means of a continuity checker, as shown in Fig. 6, a diagram of the internal connections in the ballast is very helpful. The diagram shown here is the type used to operate two 40-watt or two 30-watt lamps on a 110-125 volt line.

How Much Will It Cost

? PART II

A discussion of the development and application of Tables of Selling Units designed for preliminary estimating. Units for Services, Conduit and Wire circuits are presented in this article.

FOR PRELIM. FIELD ESTIMATING — **UNIT COSTS FOR 3 PHASE 3 WIRE SERVICES** — LABOR RATE 1.70 PER HOUR



S.D.A — SERVICE-DROP ANCHOR
S.W. — SERVICE SWITCH
M.F. — METER FITTING
C.T.P. — CURRENT TRANSFORMER PANEL
D.M. — DEMAND METER FTG.
COMB. SW. & C.T.P. — COMBINATION SERVICE SWITCH & CURRENT TRANS. PANEL.
M.B. — METER BOARD
G. — GROUND CONN.

250 VOLTS									480 VOLTS					
TYPE	COSTS–DIRECT			SELL PRICE ①	CONTR'S. ADJUSTED PRICE	SWITCH SIZE IN AMPS.	WIRE SIZE	CONDT. SIZE INCHES	TYPE	CONTR'S. ADJUSTED PRICE	COSTS–DIRECT			SELL PRICE
	MATERIAL	LABOR									MATERIAL	LABOR		
		DIRECT LABOR	INS.&DIR. JB. COSTS	ESTIMATED IN DOLLARS								DIRECT LABOR	INS.&DIR. JB. COSTS	ESTIMATED IN DOLLARS
A	16.00	17.80	3.55	44.50		30	8	3/4	A		26.00	18.30	3.65	56.00
A	33.50	27.20	5.45	78.00		60	6	1 1/4	A		35.00	28.50	5.70	82.00
A	35.00	27.60	5.50	80.00		60	4	1 1/4	A		37.00	29.00	5.80	84.50
A	44.00	30.00	6.00	93.75		100	4	1 1/4	A		51.00	31.00	6.20	102.50
A	47.50	35.70	7.15	106.50		100	2	1 1/2	A		53.00	36.75	7.35	116.00
A	53.00	36.55	7.30	113.50		100	1	1 1/2	A		60.50	38.00	7.60	124.00
A	78.50	46.00	9.20	156.00		200	0	2	A		89.00	46.50	9.30	168.00
A	82.00	46.00	9.60	163.00		200	00	2	A		96.50	50.50	10.10	182.50
A	88.00	50.00	10.00	172.00		200	000	2	A		102.00	53.50	10.70	193.00
B	146.00	75.75	15.15	275.00		200	0000	2 1/2	B		175.00	78.00	15.60	311.00
B	190.00	81.00	16.20	331.00		400	0000	2 1/2	B		224.00	84.00	16.80	374.00
B	201.00	85.00	17.00	350.00		400	250 M	2 1/2	B		236.00	88.00	17.60	393.00
B	224.00	92.00	18.40	386.00		400	350 M	3	B		258.00	96.50	19.30	430.00
B	232.00	95.50	19.10	400.00		400	400 M	3	B		266.00	100.00	20.00	444.00
B	250.00	97.00	19.40	422.00		400	500 M	3	B		283.00	102.00	20.40	466.00
B	323.00	114.00	22.80	528.00		600	600 M	3 1/2	B		383.00	117.00	23.40	598.00
B	335.00	116.00	23.20	545.00		600	700 M	3 1/2	B		399.00	121.00	24.20	622.00
B	362.00	125.00	25.00	587.00		600	800 M	4	B		422.00	132.00	26.40	664.00
B	379.00	130.00	26.00	614.00		600	900 M	4	B		439.00	136.00	27.20	689.00
B	530.00	163.00	32.60	830.00		800	2 SETS 500 M	2 CONDTS. 3						
B	730.00	240.00	48.00	1168.00		1200	3 SETS 500 M	3 CONDTS. 3						
C	462.00	153.00	30.60	740.00		800	2 SETS 500 M	2 CONDTS. 3						
C	681.00	228.00	45.60	1094.00		1200	3 SETS 500 M	3 CONDTS. 3						

①—INCLUDES MTS. FRAMES AND FUSES.

MARKUPS { MATERIAL—10% ADDED FOR OPERATING COSTS AND RETURN
LABOR—15% ADDED FOR OH. AND 10% FOR RETURN

ELECTRICAL CONTRACTORS ASS'N. OF CITY OF CHICAGO
R.W.A. 3-30-48

THE first article of this series emphasized the advantages of having tables of estimated selling units, covering the various phases of electrical installation work, for the purpose of compiling quick, accurate preliminary estimates. Most contractors appreciate the value of such tables, but few take the time to prepare them. Realizing this, the Electrical Contractors Association of City of Chicago devoted part of its program to the development of such units.

The preliminary estimating tables appearing with this and future articles of this series were prepared by the

SIZE				MATER				
WIRE	COND.	SWITCH	TYPE	SER. HEAD	CONDUIT	WIRE	ELLS	SW
		COLUMN →		A	B	C	D	
400 MCM	3"	400 A	B	7.00	14.50	50.00	4.00	56
500 MCM	3"	400 A	B	7.00	14.50	64.50	4.00	56

← ***TABLE I—Unit costs for services covering 3-phase, 3-wire, 240-volt systems. Fill in the adjusted price column to fit your own needs.***

By Ray Ashley
Research Engineer
Electrical Contractors
Association of City of Chicago

above organization in conjunction with the cost data committee of the Chicago Electrical Estimators' Association which provided data for checking the preliminary tables and proved the findings against actual established field costs.

Preparation of reliable and complete tables requires much time and care. One must be able to visualize all the details and requirements of a job. Usually sketches—each one representing a logical portion of a complete installation—are necessary to enable one to portray just what items are to be included in a single unit. Sets of tables should be compiled so that a combination of units may be selected to cover everything essential to a specific type of installation.

Table I, "Unit Cost for 3-Phase, 3-Wire Services," is a good example of combining several individual material and labor items to produce complete selling units for simple, speedy preliminary estimating purposes—a method that reduces the danger of underestimating quantities or completely omitting portions of the material and labor requirements. The requirements for heavier services (See Fig. 1, conventional estimate) embrace as many as 22 individual material and labor items—many of which may be underestimated or overlooked in field estimating. Such items as service plates, fuses, meter wiring, grounding, mounting frames, etc., may get by an esti-

CHI. ELECT. EST. ASSOC. FORM 4

PRICING SHEET DATE AUG. 15 1945

JOB OR BLDG. ELECTRIC SERVICE LOCATION CONVENTIONAL
BID TO 400 AMP. SIZE ADDRESS ESTIMATE
ARCHT. OR ENG'R. 3-500 MCM. IN 3" COND. ADDRESS
PLANS MARKED SCALE SPEC. No. EST. No. 1
EST. BY PRICED BY EXTENSIONS BY CHECKED BY S.O.No. SHEET No. 1

	MATERIAL	QUANTITY	MATERIAL UNIT	EXTENSION	LABOR UNIT	EXTENSION
	3" SERVICE HEAD & COVER	1	700	700	400	400
	3" CONDUIT	30'	4500/C'	1440	.45	13 50
	500 MCM. R.C. CABLE	140'	46000/M'	6440	.12	16 80
	3" ELL & COUPLING	1	400	400	400	400
	HOLE IN WALL - 3" COND.	1	—	—	350	350
	SERVICE PL. & BOLTS	1	150	150	350	350
	400 AMP. FUSED SAFETY SW.	1	5600	5600	1800	1800
	C.T. PAN & CABINET (Furn. by Others)	1	5300	5300	1500	1500
	400 AMP. RENEWABLE FUSES	3	500	1500	—	—
METERING	30 AMP. RENEWABLE FUSES	2	30	60	—	—
METERING	30 AMP. METER FITTING	1	350	350	350	350
METERING	METER BOARD - 30"x 36"x 1½"	1	400	400	200	200
METERING	¾" CONDUIT	20'	7.50/C'	150	.10	200
METERING	No. 12 R.C. WIRE	100'	10.00/M'	100	.01	100
METERING	¾" "E" COND. FITTING - 4-Hole Cap	2	50	100	50	100
METERING	¾" "LB" " " - BLANK COVER	1	40	40	40	40
GRND.	¾" CONDUIT	25'	7.50/C'	190	.08	200
GRND.	No. 4 WIRE	30'	50.00/M'	150	.03	90
GRND.	GROUND FITTING - ¾" COND.	1	75	75	75	75
	MOUNTING FRAMES	1	350	350	INCLUDED WITH MATERIAL	
	3" INSULATED BUSHINGS	3	150	450	—	—
	3" LOCKNUTS	6	15	90		
				2403.5		9185
	INCIDENTALS			700		500
				2473.5		9685
	INSURANCES				16.5%	1400
	DIRECT JOB COSTS				60%	600
				2473.5		11685
	GEN. OVERHEAD & ADM.		5%	1240	15%	1750
				2597.5		13435
	RETURN		5%	1300	10%	1345
	EST. SELLING PRICE - MATERIAL			$ 2727.5		$ 14780
	" " " - LABOR			1478.0		
	" " " - TOTAL			$ 4205.5		

FIG. 1—Conventional estimate for a service installation. Check with Table I and note that the selling price of $422 can be picked right out of the column, eliminating the work outlined above.

SERVICE UNITS - WORK SHEET
3-PHASE, 3-WIRE, 240 VOLTS (30' CONDUIT)

COST								MATERIAL EST. SELL. PRICE COL "N" + 10%	LABOR COST											LABOR EST. SELL. PRICE COL "X" +20+15+10%	UNITS FOR TABLES			
BD. & CONN.	SER. PL. & BOLTS	GRD.	FUSES	MT'G FRAMES	MISC.	TOTAL "A" TO "M"			SER. HEAD	COND-UIT	WIRE	ELLS	HOLE IN WALL	SWITCH	METER EQPT.	SER. PL.	GRD.	MISC.	TOTAL "P" TO "Y"		COSTS MAT.	COSTS LABOR	INS. & DIRECT JOB COST 20% LABOR	SELLING UNIT
H	I	J	K	L	M	N	O		P	Q	R	S	T	U	V	W	X	Y	Z	A-A				
800	1.50	4.50	15.90	3.00	11.00	231.90	255.00		4.00	14.00	16.00	4.00	3.50	18.00	24.50	3.00	3.50	5.00	95.50	145.00	232.00	95.50	19.10	400.00
850	1.50	4.50	15.90	3.50	11.50	247.90	273.00		4.00	14.00	17.00	4.00	3.50	18.00	25.00	3.00	3.50	5.00	97.50	149.00	250.00	97.00	19.50	422.00

FIG. 2—Work sheet for service units—a convenient means of tabulating all material and labor cost item plus selling price. Sheet is basis of unit cost selling tables; also a handy reference for picking out specific cost items.

SHEET 1

APPROX. COST PER CIRCUIT FT. OF CONDT. & WIRES ON CONCRETE

LABOR RATE-1.70 PER HR. GALV. CONDT. CODE WIRE INST. ON 12 FT. CONC. CEIL.

UNITS ARE ONLY RELATIVE AND HAVE TO BE VARIED ACCORDING TO THE INDIVIDUAL CONTR'S. EXPERIENCE

WIRE SIZE & NUMBER	COND. SIZE	SELL PRICE PER FOOT EST. [(A+B+D) +10%] +100	CONTR'S. ADJ. PRICE MARK UP	CONTR'S. ADJ. PRICE SELL PRICE	EST. COST PER 100 FT. MATERIAL SEE NOTES WIRE 110FT/LEG A	MATERIAL CONDUIT & ELS. B	LABOR INST. COST-COND. & WIRE C	LABOR +20% INS. & J.C. +15% GEN. OH. D
2 NO. 14	1/2"	.30			1.60	7.00	13.90	19.00
3 NO. 14	1/2"	.33			2.40	7.00	14.90	20.50
4 NO. 14	1/2"	.35			3.20	7.00	15.90	21.90
5 NO. 14	3/4"	.41			4.00	8.90	17.80	24.50
6 NO. 14	3/4"	.44			4.80	8.90	18.80	26.00
2 NO. 12	1/2"	.32			2.20	7.00	14.40	19.80
3 NO. 12	1/2"	.35			3.30	7.00	15.65	21.50
4 NO. 12	3/4"	.42			4.40	8.90	17.80	24.50
5 NO. 12	3/4"	.45			5.50	8.90	18.80	26.00
6 NO. 12	3/4"	.48			6.60	8.90	20.00	27.50
2 NO. 10	3/4"	.38			3.30	8.90	16.00	22.10
3 NO. 10	3/4"	.42			4.95	8.90	17.60	24.25
4 NO. 10	3/4"	.47			6.60	8.90	19.00	26.20
2 NO. 8	3/4"	.42			5.70	8.90	16.80	23.20
3 NO. 8	1"	.57			8.55	13.00	22.00	30.40
4 NO. 8	1"	.63			11.40	13.00	24.00	33.20
2 NO. 6	1"	.56			8.80	13.00	21.00	29.00
3 NO. 6	1-1/4"	.77			13.20	17.30	26.50	39.40
4 NO. 6	1-1/4"	.85			17.60	17.30	31.00	42.60
2 NO. 4	1 1/4"	.73			11.40	17.30	27.00	37.20
3 NO. 4	1 1/4"	.83			17.10	17.30	30.00	41.40
4 NO. 4	1 1/2"	1.04			22.80	21.00	37.00	51.00
2 NO. 3	1 1/4"	.77			14.50	17.30	28.00	38.60
3 NO. 3	1 1/4"	.91			21.75	17.30	31.50	43.50
4 NO. 3	1 1/2"	1.14			29.00	21.00	39.00	53.75
2 NO. 2	1 1/4"	.81			16.50	17.30	29.00	40.00
3 NO. 2	1 1/2"	1.07			24.75	21.00	37.50	51.50
4 NO. 2	1 1/2"	1.21			33.00	21.00	40.50	56.00
2 NO. 1	1 1/2"	1.01			23.60	21.00	34.00	47.00
3 NO. 1	1 1/2"	1.19			35.40	21.00	38.00	52.50
4 NO. 1	2"	1.57			47.25	29.00	48.00	66.25

NOTES
1-MAT. PRICES INCL. ALLOW. FOR SALES TAX, SHRINKAGE, ELS. (2/100FT.), FASTENINGS, TAPE, SOL., ETC.
2-20% IS ADDED TO LABOR FOR INS., TOOLS AND OTHER DIRECT JOB COSTS.
3-MARK UPS MATERIAL-10% ADDED FOR OPER. COSTS & RETURN. LABOR-15% ADDED FOR OH. & 10% FOR RETURN.

BASE PRICES 1/2" COND.--- 6.05 NO.14 WIRE--- 2.35

ELECTRICAL CONTRACTORS' ASS'N. OF CITY OF CHICAGO 5-10-44

SHEET 2

APPROX. COST PER CIRCUIT FT. OF CONDT. & WIRES ON CONCRETE

LABOR RATE-1.70 PER HR. GALV. CONDT. CODE WIRE INST. ON 12 FT. CONC. CEIL.

UNITS ARE ONLY RELATIVE AND HAVE TO BE VARIED ACCORDING TO THE INDIVIDUAL CONTR'S EXPERIENCE.

WIRE SIZE & NUMBER	COND. SIZE	SELL PRICE PER FOOT EST. [(A+B+D) +10%] +100	CONTR'S. ADJ. PRICE MARK UP	CONTR'S. ADJ. PRICE SELL PRICE	EST. COST PER 100 FT. MATERIAL SEE NOTES WIRE 110FT/LEG. A	MATERIAL CONDUIT & ELS. B	LABOR INST. COST-COND. & WIRE C	LABOR +20% INS. & J.C. +15% GEN. OH. D
2 NO. 0	1 1/2"	1.09			28.20	21.00	36.00	48.60
3 NO. 0	2"	1.51			42.30	29.00	48.00	66.00
4 NO. 0	2"	1.73			56.40	29.00	52.00	72.00
2 NO. 00	2"	1.38			34.00	29.00	45.00	62.00
3 NO. 00	2"	1.65			51.00	29.00	51.00	70.50
4 NO. 00	2 1/2"	2.24			68.00	45.40	65.00	90.00
2 NO. 000	2"	1.48			40.60	29.00	47.00	65.00
3 NO. 000	2"	1.80			60.90	29.00	54.00	74.50
4 NO. 000	2 1/2"	2.43			81.20	45.40	69.00	95.50
2 NO. 0000	2"	1.59			48.00	29.00	49.00	67.50
3 NO. 0000	2 1/2"	2.29			72.00	45.40	66.00	91.00
4 NO. 0000	2 1/2"	2.65			96.00	45.40	72.50	100.00
2-250 M	2 1/2"	2.07			60.00	45.40	60.00	83.00
3-250 M	2 1/2"	2.52			90.00	45.40	68.00	94.00
4-250 M	3"	3.37			120.00	64.00	88.00	122.00
2-300 M	2 1/2"	2.17			68.00	45.40	61.00	84.00
3-300 M	3"	3.09			102.00	64.00	83.50	115.00
4-300 M	3"	3.57			136.00	64.00	91.00	125.00
2-350 M	2 1/2"	2.26			76.00	45.40	62.00	85.50
3-350 M	3"	3.25			114.00	64.00	85.00	117.00
4-350 M	3 1/2"	4.18			152.00	85.00	104.00	143.50
2-400 M	3"	2.84			88.00	64.00	77.00	106.00
3-400 M	3"	3.50			132.00	64.00	88.00	122.00
4-400 M	3 1/2"	4.44			176.00	85.00	108.00	149.00
2-500	3"	3.07			106.00	64.00	79.00	109.00
3-500 M	3"	3.83			159.00	64.00	91.00	125.00
4-500 M	3 1/2"	4.95			212.00	85.00	111.00	153.00
2-600 M	3"	3.41			134.00	64.00	81.00	112.00
3-600 M	3 1/2"	4.74			201.00	85.00	105.00	145.00
4-600 M	4"	5.93			268.00	101.00	123.00	170.00
2-750 M	3 1/2"	4.15			160.00	85.00	96.00	132.00
3-750 M	3 1/2"	5.26			240.00	85.00	111.00	153.00
4-750 M	4 1/2"	7.06			320.00	124.00	144.00	198.00

NOTES
1-MAT. PRICES INCL. ALLOW. FOR SALES TAX, SHRINKAGE, ELS. (2/100FT.), FASTENINGS, TAPE, SOL., ETC.
2-20% IS ADDED TO LABOR FOR INS., TOOLS, AND OTHER DIRECT JOB COSTS.
3-MARK UPS MATERIAL-10% ADDED FOR OPER. COSTS & RETURN. LABOR-15% ADDED FOR OH. & 10% FOR RETURN.

BASE PRICES 1/2" COND.--- 6.05 NO.14 WIRE--- 2.35

ELECTRICAL CONTRACTORS' ASS'N. OF CITY OF CHICAGO 5-10-44

TABLE II—Unit costs for conduit and wire installations on a per circuit-foot basis. Add your own units, based on local conditions, in the adjusted price column.

SHEET 3

APPROX. COST PER CIRCUIT FT. OF CONDT. & WIRES ON WOOD CEIL.

LABOR RATE-1.70 PER HR. GALV. CONDT. CODE WIRE INST. ON 12 FT. WOOD CEIL.

UNITS ARE ONLY RELATIVE AND HAVE TO BE VARIED ACCORDING TO THE INDIVIDUAL CONTR'S. EXPERIENCE.

WIRE SIZE & NUMBER	COND. SIZE	SELL PRICE PER FOOT EST. [(A+B+D) +10%] +100	CONTR'S. ADJ. PRICE MARK UP	CONTR'S. ADJ. PRICE SELL PRICE	EST. COST PER 100 FT. MATERIAL SEE NOTES WIRE 110FT/LEG A	MATERIAL CONDUIT & ELS. B	LABOR INST. COST-COND. & WIRE C	LABOR +20% INS. & J.C. +15% GEN. OH. D
2 NO. 14	1/2"	.25			1.60	6.50	10.30	14.20
3 NO. 14	1/2"	.27			2.40	6.50	11.15	15.35
4 NO. 14	1/2"	.29			3.20	6.50	12.15	16.75
5 NO. 14	3/4"	.35			4.00	8.40	13.70	18.90
6 NO. 14	3/4"	.37			4.80	8.40	14.60	20.15
2 NO. 12	1/2"	.26			2.20	6.50	10.80	14.90
3 NO. 12	1/2"	.28			3.30	6.50	11.50	15.85
4 NO. 12	3/4"	.35			4.40	8.40	14.00	19.35
5 NO. 12	3/4"	.39			5.50	8.40	15.25	21.10
6 NO. 12	3/4"	.42			6.60	8.40	16.50	22.80
2 NO. 10	3/4"	.32			3.30	8.40	12.40	17.10
3 NO. 10	3/4"	.36			4.95	8.40	14.00	19.35
4 NO. 10	3/4"	.40			6.60	8.40	15.60	21.50
2 NO. 8	3/4"	.36			5.70	8.40	13.20	18.20
3 NO. 8	1"	.51			8.55	12.25	18.50	25.50
4 NO. 8	1"	.57			11.40	12.25	20.50	28.30
2 NO. 6	1"	.50			8.80	12.25	17.50	24.20
3 NO. 6	1-1/4"	.68			13.20	16.50	23.50	32.40
4 NO. 6	1 1/4"	.76			17.60	16.50	25.50	35.10
2 NO. 4	1 1/4"	.64			11.40	16.50	22.00	30.40
3 NO. 4	1 1/4"	.76			17.10	16.50	25.50	35.10
4 NO. 4	1 1/2"	.96			22.80	20.20	32.40	44.60
2 NO. 3	1 1/4"	.69			14.50	16.50	23.00	31.80
3 NO. 3	1 1/4"	.82			21.75	16.50	26.50	36.60
4 NO. 3	1 1/2"	1.06			29.00	20.20	34.30	47.25
2 NO. 2	1 1/4"	.72			16.50	16.50	23.80	32.80
3 NO. 2	1 1/2"	.99			24.75	20.20	32.50	44.75
4 NO. 2	1 1/2"	1.12			33.00	20.20	35.50	49.00
2 NO. 1	1 1/2"	.92			23.60	20.20	29.00	40.00
3 NO. 1	1 1/2"	1.10			35.40	20.20	33.00	45.50
4 NO. 1	2"	1.47			47.20	27.25	43.20	59.50

NOTES
1-MAT. PRICES INCL. ALLOW. FOR SALES TAX, SHRINKAGE, ELS. (2/100 FT.), FASTENINGS, TAPE, SOL., ETC.
2-20% IS ADDED TO LABOR FOR INS., TOOLS, AND OTHER DIRECT JOB COSTS.
3-MARK UPS MATERIAL-10% ADDED FOR OPER. COSTS & RETURN. LABOR-15% ADDED FOR OH. & 10% FOR RETURN.

BASE PRICES 1/2" COND.--- 6.05 NO.14 WIRE--- 7.30

ELECTRICAL CONTRACTORS' ASS'N. OF CITY OF CHICAGO 5-10-44

SHEET 4

APPROX. COST PER CIRCUIT FT. OF CONDT. & WIRES ON WOOD CEIL.

LABOR RATE-1.70 PER HR. GALV. CONDT. CODE WIRE INST. ON 12 FT. WOOD CEIL.

UNITS ARE ONLY RELATIVE AND HAVE TO BE VARIED ACCORDING TO THE INDIVIDUAL CONTR'S. EXPERIENCE.

WIRE SIZE & NUMBER	COND. SIZE	SELL PRICE PER FOOT EST. [(A+B+D) +10%] +100	CONTR'S. ADJ. PRICE MARK UP	CONTR'S. ADJ. PRICE SELL PRICE	EST. COST PER 100 FT. MATERIAL SEE NOTES WIRE 110FT/LEG A	MATERIAL CONDUIT & ELS. B	LABOR INST. COST-COND. & WIRE C	LABOR +20% INS. & J.C. +15% GEN. OH. D
2 NO. 0	1 1/2"	1.00			28.20	20.15	31.00	42.80
3 NO. 0	2"	1.42			42.30	27.25	43.00	59.40
4 NO. 0	2"	1.64			56.40	27.25	47.00	65.00
2 NO. 00	2"	1.28			34.00	27.25	40.00	56.00
3 NO. 00	2"	1.56			51.00	27.25	46.00	63.50
4 NO. 00	2 1/2"	2.12			68.00	43.00	59.00	81.50
2 NO. 000	2"	1.38			40.60	27.25	42.00	58.00
3 NO. 000	2"	1.71			60.90	27.25	49.00	67.50
4 NO. 000	2 1/2"	2.32			81.20	43.00	63.00	87.00
2 NO. 0000	2"	1.49			48.00	27.25	44.00	60.50
3 NO. 0000	2 1/2"	2.18			72.00	43.00	60.00	83.00
4 NO. 0000	2 1/2"	2.54			96.00	43.00	66.50	91.50
2-250 M	2 1/2"	1.95			60.00	43.00	53.50	74.00
3-250 M	2 1/2"	2.41			90.00	43.00	63.25	86.00
4-250 M	3"	3.17			120.00	59.00	79.00	109.00
2-300 M	2 1/2"	2.06			68.00	43.00	55.00	76.00
3-300 M	3"	2.90			102.00	59.00	74.50	103.00
4-300 M	3"	3.39			136.00	59.00	82.00	113.00
2-350 M	2 1/2"	2.16			76.00	43.00	56.00	77.50
3-350 M	3"	3.06			114.00	59.00	76.00	105.00
4-350 M	3 1/2"	3.97			152.00	79.50	94.00	130.00
2-400 M	3"	2.65			88.00	59.00	68.00	94.00
3-400 M	3"	3.30			132.00	59.00	79.00	109.00
4-400 M	3 1/2"	4.29			176.00	79.50	98.00	135.00
2-500 M	3"	2.88			106.00	59.00	70.00	97.00
3-500 M	3"	3.64			159.00	59.00	82.00	113.00
4-500 M	3 1/2"	4.74			212.00	79.50	101.00	139.00
2-600 M	3"	3.20			134.00	59.00	72.00	99.00
3-600 M	3 1/2"	4.53			201.00	79.50	95.00	131.00
4-600 M	4"	5.69			268.00	94.00	112.00	155.00
2-750 M	3 1/2"	3.93			160.00	79.50	86.00	118.00
3-750 M	3 1/2"	5.04			240.00	79.50	101.00	139.00
4-750 M	4 1/2"	6.78			320.00	116.00	131.00	180.00

NOTES
1-MAT. PRICES INCL. ALLOW. FOR SALES TAX, SHRINKAGE, ELS. (2/100 FT.), FASTENINGS, TAPE, SOL., ETC.
2-20% IS ADDED TO LABOR FOR INS., TOOLS, AND OTHER DIRECT JOB COSTS.
3-MARK UPS MATERIAL-10% ADDED FOR OPER. COSTS & RETURN. LABOR-15% ADDED FOR OH. & 10% FOR RETURN.

BASE PRICES 1/2" COND.--- 6.05 NO.14 WIRE--- 7.30

ELECTRICAL CONTRACTORS' ASS'N OF CITY OF CHICAGO 5-10-44

mator under ordinary conditions, and more so when setting up quick preliminary figures.

Cable for services is frequently underestimated, being out of proportion to the conduit requirements. Allowances must be made for service drop, main switch, and metering transformer cabinet connections, as well as for the waste caused by cutting and numerous trimming cable ends.

With all the pertinent material and labor items included in a single unit, as shown in Table I, the estimator need not worry about numerous small details—the cost of which, when compared to the return ordinarily secured, may add up to a considerable sum.

Developing the Units

At best, it requires considerable time and effort to prepare a table of unit costs. One must adopt some system which will minimize expended time and, at the same time, provide a means of readily checking his work. Before the final units are established, preliminary tables are prepared and checked against actual installation costs.

Three basic steps are involved in the development of unit costs for preliminary estimating purposes:

1. *Conventional Estimates* listing all of the necessary material and labor items (similar to that for services, Fig. 1) are used as a guide in the preparation of the work sheet. For 220-volt services, for example, four such estimates would be required—one for 220-, 400-, 600-, and 800-amp. switches. Each estimate should be prepared so that items of specific sections—such as meter wiring, grounding, miscellaneous items—can be quickly spotted and summed up into a unit cost.

2. *A Work Sheet* is prepared to tabulate the material and labor cost of each item that goes into a service installation (See Fig. 2). Cost items for different sized services are listed on the one sheet; also for different size service conductors to the same size switch. Such a tabulation saves considerable time over conventional estimates since all services requiring the same size switch have practically the same cost items for everything except cable and, in some cases, conduit. Identical cost items are repeated in the proper columns of the work sheet. The work sheet provides a handy reference for picking out specific cost items of the installation involved and should be retained for such use.

3. *The Unit Cost Sheet* indicating the estimated selling price of the service installations (Table I) embodies the last four columns of the work sheet (Units for Tables). Sketches at the top of the sheet illustrate the equipment involved in the services listed.

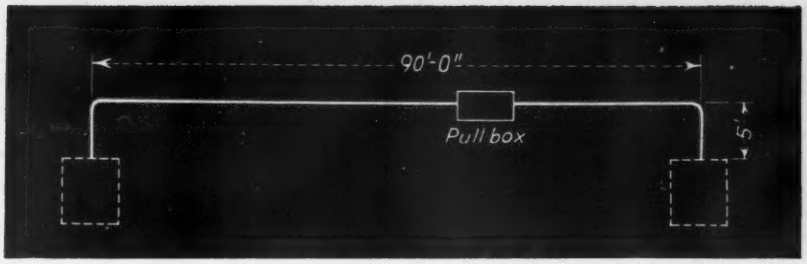


FIG. 3—Typical conduit run on which "Wire and Conduit" cost sheet units are based.

The Unit Cost Tables

In the preparation of the final unit cost tables, three important factors must be kept in mind:

1. All items, pertaining to or allied with the branch of work involved, should be included.

2. Base costs (without markup) of labor and material should be listed.

3. Space should be provided for *adjusted units.*

The necessity of having units embracing a complete branch of the work is more or less obvious and the following discussion on conduit and wire units will further emphasize this point.

The listing of base material and labor costs is recommended for the following reasons:

1. It enables one, not familiar with the actual development of the units, to more readily get his bearings.

2. Base costs provide a means of quickly checking other estimates.

3. Adjustments can be readily made

[Continued on Page 238]

APPLICATION OF CONDUIT-WIRE TABLES

PRELIMINARY ESTIMATE for the following feeders to be mounted exposed on a 12-ft. concrete ceiling:

Feeder No. 1—3 No. 1 in 1½" C.—110 ft.
Feeder No. 2—3 No. 4 0 in 2½" C.—120 ft.
Feeder No. 3—4 No. 4 0 in 2½" C.—90 ft.
Feeder No. 4—4 No. 1 0 in 2" C.—160 ft.

Using Table II, sheets 1 and 2—estimated selling price per circuit-foot, the preliminary estimate would be:

3 No. 1	—1½" C. 110 ft.	@	$1.19	$130.90
3 No. 4 0	—2½" C. 120 ft.	@	2.29	274.80
4 No. 4 0	—2½" C. 90 ft.	@	2.65	238.50
4 No. 1 0	—2" C. 160 ft.	@	1.73	276.80
			Estimated Selling Price	$921.00

TO CHECK CONVENTIONAL ESTIMATE — bare cost of material and labor. Using Table II, sheet 2, units in columns A, B and C.

	Wire	Cond.	Total Material	Total Labor
4—500 MCM. in 3½" C. —150 ft.	$318.00	$127.50	$445.50	$166.50
4—400 MCM. in 3½" C. —100 ft.	176.00	85.00	261.00	108.00
4—250 MCM. in 3" C. —50 ft.	60.00	32.00	92.00	44.00

Note: For mounting on 12-ft. concrete ceiling units on sheets 1 and 2 are used; for 12-ft. wood ceiling, sheets 3 and 4.

FIG. 4—Application of tables to preliminary feeder estimates and for checking feeder costs on conventional estimates.

Simplified Supports

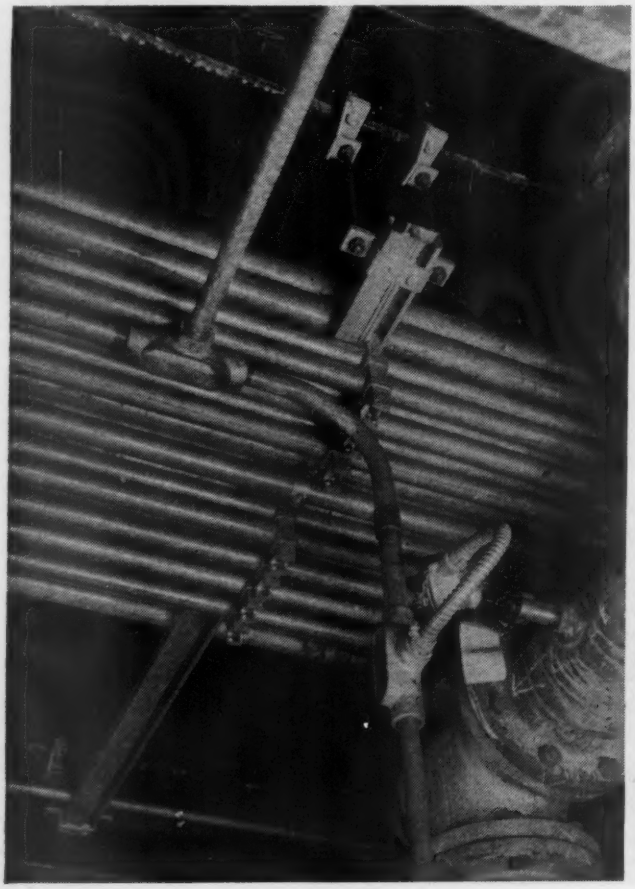
Featuring strength, installation ease and flexibility, and salvability — a new structural framing member "Unistrut" solves numerous "mounting" problems in the electrical construction field.

By August Eckel

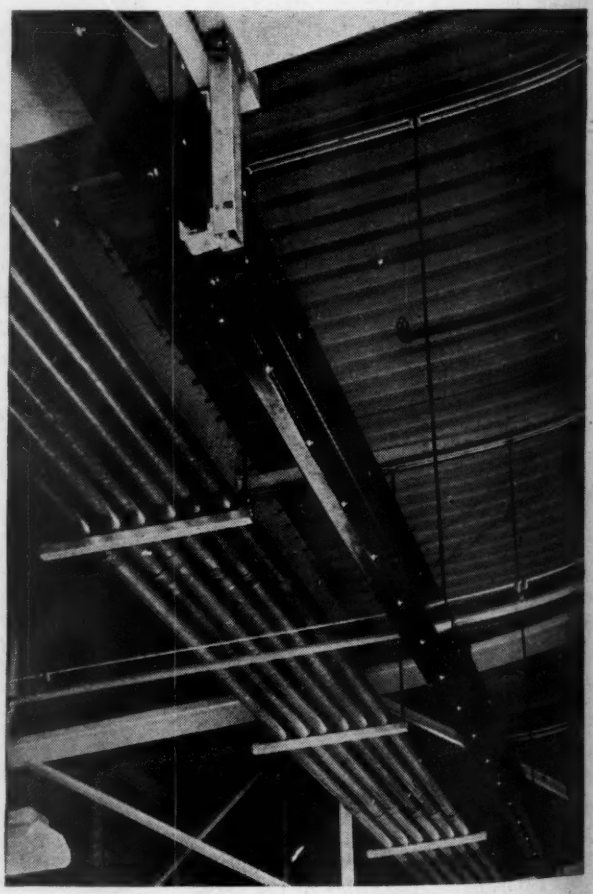
DURING the war years, the construction industry, in general, developed many new techniques to accelerate building construction and improve structural design. Many of these were made by the builder in the field. Others were the result of fabricators' efforts. The combination of all these ideas and devices constituted the "know how" behind the war plant construction miracle—buildings erected within time limits that one never dared consider.

One such development was of particular benefit to the "pipe trades" of the construction fraternity. It is a single all-purpose structural framing member called "Unistrut," developed in 1939 by Charles A. Attwood, an architect who spent most of his career associated with the industrial construction field. It is his answer to the construction industry's requirements for a structural member so designed that a nut and bolt could be placed anywhere along its length and held rigidly to the desired location after bolting another member to it. In short—it eliminates all punching and drilling for bolted connections, and it has been dubbed "the man-sized building set." Its uses are many.

The framing member is a square formed, $1\frac{5}{8}$-in. steel channel with one open side forming a $\frac{7}{8}$-in. continuous slot. Each side of this slot has an inturned edge or clamping ridge for the specially designed nut used in the bolted connections. Recommended load limits on these flanges are 1000 lbs. per bolt (steel to steel connection) with



***DOUBLE STRUT TRAPEZE** with beam clamp mounting supports this multi-tier of conduits.*



***TEE HANGER** and trapeze support bus duct and conduit feeders in this plant. Single strut is used.*

bolts on a minimum 4-inch center to center distance. Weight of the unit, furnished in standard 20-ft. lengths, is two pounds per foot.

The special hardened steel nut for use with the strut is rectangular in shape, equipped with a steel spring to hold it in position while the bolt is being threaded into it, and contains two serrated grooves which engage the pyramid-shaped clamping ridges of the strut when the the bolt is tightened. Tests revealed that the nut will resist longitudinal movement up to 700 to 900 pounds pull per bolt (steel to steel). The nut, second strut member and bolt, when tightened, bridges the slot in the strut forming a complete channel section with much greater strength at the specific point where the load is applied.

Combined with a number of simple, ¼-inch thick pressed steel plate, angle and clevis shapes, beam clamps, conduit clamps, bus and cable supports, the strut comprises a structural set that can be used for many construction and industrial purposes.

Numerous Advantages Cited

Having been introduced just prior to the war, this system was used extensively in war plant construction and operation, proving itself to the satisfaction of all concerned. The "pipe trades" in particular found it a welcome answer to their suspension and supporting problems. Plant operating and maintenance departments found it a quick efficient means of fabricating storage racks, table and bench frames, free-standing and wall mounted equipment supports.

In the electrical field it found extensive use for conduit cable, bus bar, bus duct and trolley duct suspensions. Supporting framework for various types of electrical equipment and controls were made from it in record time. It provided convenient motor rails. And, if a change in plans occurred every bit of the strut and accessories was salvable for reuse.

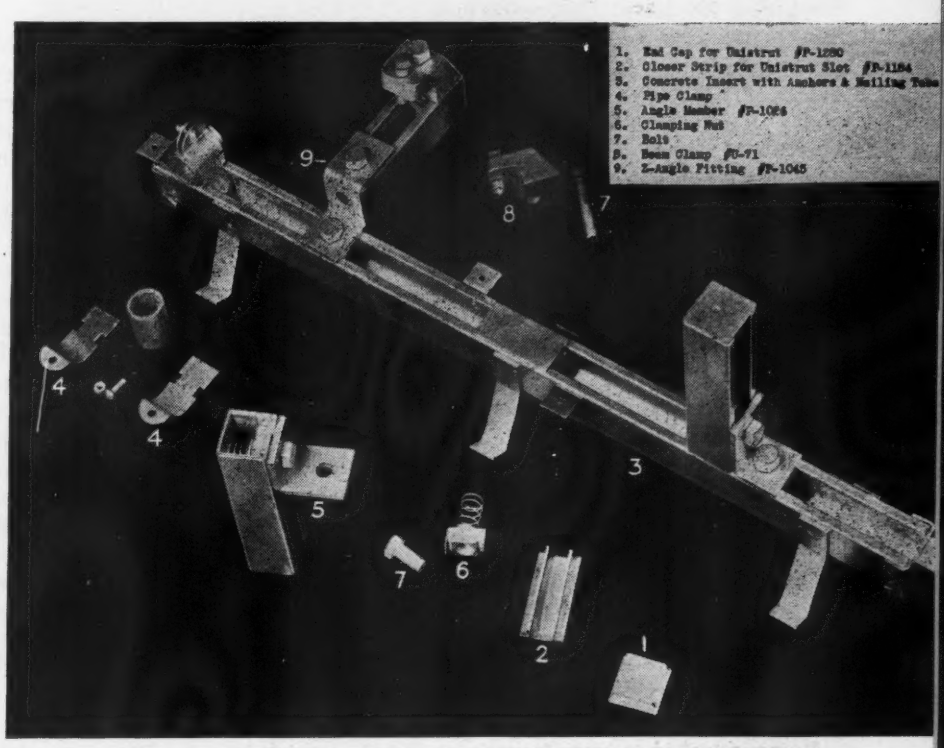
Contractors, plant engineers, and mechanics alike who have installed hundreds of thousands of feet of this structural member have cited the following definite advantages:

1. *Saves Time*—Supporting structures made of conventional angle, flat and channel iron require careful, accurate measurements for punching and drilling mounting holes for equipment and framework joints. Whether fabricated in the field or in the shop, any error usually meant discarding the particular member or utilizing some make-

[Continued on page 80]



***HOIST RAIL** in this plant is a triple strut combination. The 40-ft. rail, suspended from three strut A-hangers, carries a 1-ton hoist.*



***COMPONENT PARTS** of the Unistrut system shown above illustrates the flexibility of this structural method.*

***CANTILEVER STRUT**, mounted to steel truss by beam clamps, supports bus duct line. Rod supports to monitor roof are eliminated.*



SILICONE INSULATION for Maintenance

By
Walter Rupprecht
Superintendent of Electrical Dept.
The Dow Chemical Company

THE primary interest of industrial plants is to meet production schedules, and chemical plants are no exception. Electrical machines, and particularly motors, are often abused to meet these schedules. Production men tend to take the continuous operation of motors for granted and often do not realize that they have been running above the factor of safety until the machine fails. In addition, wartime restrictions on critical materials, particularly on electrical apparatus, has further tended toward overloading equipment.

Electrical Maintenance in a Chemical Plant

In a chemical plant, along with the greater production demands upon electrical equipment, maintenance men must contend with extreme service conditions in which chemicals and solvents combine with moisture and heat to break down insulation resistance. Motors are our biggest maintenance problem. About 75 percent of our motor failures have been traced to moisture getting into the windings and most of these were in the slots where water collected. We know that lots of failures are first due to mechanical defects; for example, the formation of tiny cracks and voids in the insulation due to movements of the windings. But moisture, together with chemicals, is the ultimate cause of most of our failures.

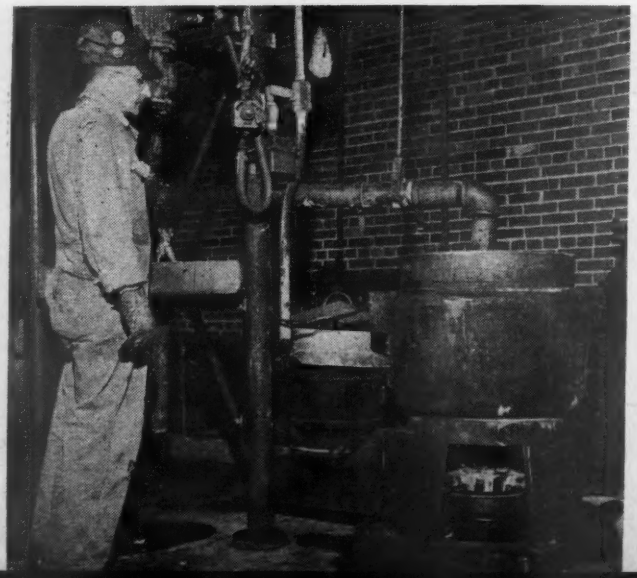
Our greatest problems have been with the insulating materials used in motors and other electrical equipment. In our plant, we are confronted with all kinds of chemicals which deteriorate insulation. Some oxidize the insulation and destroy it. Others, like calcium chloride, gather on the insulation and dissolve in moisture taken from the air. Still others are solvents which dissolve the varnish and weaken the insulation. Insulating materials must therefore withstand acids, gases, salts, solvents and moisture. Added to these is heat due to overloading or to high ambient temperatures.

We have been working for many years to improve the life of motors and electrical equipment used in chemical plants. Some of this work has been done in our own shops and some in cooperation with manufacturers of electrical equipment. Years ago, when the only insulation available was entirely Class A, we had a lot of motor failures due to breakdown of the organic insulation. In order to reduce some of the reoccurring failures, we began to use mica in the slots and for phase insulation. This could be done only when there was sufficient space to add the mica but it did afford some relief.

The next improvement came from the use of mica and asbestos tapes. When these became available, we used them to rewind jobs and again reduced the rate of failure. Even so, parts of the job were still Class A; namely, cotton covered enameled wire, the slot wedges and the organic insulating varnishes. We had a great deal of trouble applying the mica tape because of its fragile paper backing.

We worried along with this type of a rewind procedure for a number of

Motors attached to centrifuges in one of the crystalizer rooms are frequently overloaded. Motors are equipped with thermal overload protectors which save them from burning out, but production is interrupted for about ten minutes every time the motor kicks out. After motors were rewound with Silicone Insulation, higher amperage protectors were installed.



The motor driving this batch centrifuge had a service life of less than six months. Organic solvents and moisture, combined with heating caused by initial overloads, contributed to the early failure of this motor. Rewound with silicone Insulation and impregnated with DC 993, this motor is still in excellent condition after a year of service.



How an electrical maintenance department uses silicone insulations.



This 7½ hp. motor, direct connected to a centrifugal pump, had a service life of six to nine months when wound with Class B insulation. The motor is used to pump a salt slurry from the settling cone of an evaporator and is subject to frequent overloads when the slurry becomes heavy. The motor is located in a pit beneath the evaporator and is frequently hosed off to remove encrusted salts. Rewound with Silicone Insulation and impregnated with Dow Corning 993 Silicone Varnish, this motor is still in service after two years of uninterrupted service.

years until asbestos covered wire came along. This looked good at first but our expectations were not fulfilled. The asbestos covered wire had a lot of bare spots which gave us trouble from shorted turns and coils. In addition, the asbestos covering picked up and retained a certain amount of moisture. This last characteristic of the wire was the most discouraging and we finally gave up trying to use it.

Next came Class B insulation with glass served magnet wire, mica-glass slot insulation and finally glass tape, sleeving and tying cord. We had some difficulty in applying these materials due to the varnishes and impregnating compounds used with fibrous glass.

However, we wound a number of jobs and found that service life was increased. One motor which lasted only about three weeks with Class A insulation lasted 18 months with the more heat resistant Class B materials. This was a great improvement, but we were still far from a perfect insulation. We felt that we were not getting the service life that should be obtainable with glass and mica. The slot wedges were phenolic laminates and the only impregnating varnishes and bonding resins available were organic products. We were, therefore, hopefully waiting for better insulating varnish that could be teamed up with mica and Fiberglas to give us insulated equipment with greater ability to take our tough service conditions. This we found in the new silicones.

Rewinding Motors with Silicone Insulation

About 18 months ago, our product development men asked us to try their new d-c silicone impregnating varnish. They obtained silicone bonded Fiberglas served magnet wire, silicone varnished Fiberglas tape and silicone bonded mica-glas slot liners from several fabricators who were experimenting with the use of silicone varnish in the manufacture of silicone insulation. We wound several motors using these materials and impregnated them with silicone varnish. Most of these motors are still in operation and we have since rewound more than a dozen others.

The silicone impregnated Fiberglas magnet wire was smooth and gave the winders no trouble from unbonded glass fibers. We used mica-glass sheet insulation for the slot liners and phase insulation. Coil separators were made by laminating several thicknesses of silicone varnished glass cloth together with silicone resin. Silicone varnished Fiberglas tape and sleeving were used and all tying was done with Fiberglas cord.

The stators thus wound with silicone insulation were impregnated with silicone varnish, following the same procedures established for organic varnishes. We used our varnish baking oven for removing the solvent from the silicone impregnated machine.

In our plant, we have more than 6000 three-phase motors in all kinds of services. Most of them are connected to non-shock, easy starting loads like pumps, and fans. Many of them are overloaded and many must operate under difficult service conditions. Several overloaded motors which failed every few months were rewound with silicone insulation. For example, we have a 7½ hp. silicone insulated motor connected to a 10 hp. load in a continuously wet location pumping epsom salt solution. This motor had a service life of from six to nine months. Rewound with silicone insulation, the motor is still in service after two years.

As another example, we rewound a 20 hp., 3600 rpm. fan motor with silicone insulation. This motor is located on top of an oven for heat treating Dow metal. It has a hard starting cycle along with a high ambient temperature. This motor has been driving a 30 hp. load for about four months. Like this one, many of our fan motors are located on top of ovens and take seven to ten minutes to get up to temperature. In this period, they are overloaded from 50 to 100 percent depending upon the fan design.

We have recently rewound a motor on a batch centrifuge which was failing too frequently causing costly shut downs in one plant. We expect that silicone insulation, because of its greater chemical resistance, will give us longer life on this job.

Our experience with silicone insulation has been very promising. It should reduce very considerably the frequency with which motors on difficult services have to be brought into the shop.



FIG. 1—Show windows in Wieboldt's Chicago store attract prospective buyers by day and at night. X-Ray silver mirrored glass reflectors on 9 inch centers use 500 watt lamps. All lamps burn during day to provide high intensity lighting to combat daylight reflections. Half of the reflectors only are used at night.

SHOW WINDOW Lighting Techniques

THE art of displaying merchandise as a direct aid to selling is as old as the system of trade, or barter. Show windows have been used to display products for sale since the advent of traders, who gathered such products together to form a store, or stock. Continued use and improvement of the art of show window display vouches for its soundness.

Rapid progress in the development of shop window construction, plate glass, artificial lighting, and use of many decorative devices has permitted a high degree of display effectiveness. This is important and necessary, since the store front or show window represents the most valuable floor space in a store.



FIG. 2—Island and side windows in this Manchester, N. H. store are lighted with semi-concentrating type Holophane prismatic glass reflectors.

Specific types of merchandise require specialized display treatment. The value of display windows is dependent upon the number of persons seeing the displays. Sight requires light. Thus light becomes one of the most important elements of successful show window display.

The type of light used must enhance the displayed merchandise. This requires different types of lighting for different displays. For example, correct lighting for furniture displays would not do justice in lighting jewelry. Neither would the type light needed to enhance silverware be suitable for lighting women's fur coats. It is immediately apparent, therefore, that show windows used for displaying various types of merchandise, such as may be expected in department store windows, must be provided with highly flexible lighting effects.

Light sources and lighting devices have kept pace with progress in dis-

By Berlon C. Cooper

A discussion of requisites for good window lighting, including suitable types of lamp sources, reflectors and accessories.

play techniques. The multiplicity of light sources, lighting units, reflectors and spotlights, color accessories and shielding devices has created considerable confusion with store owners and displaymen. It has become increasingly difficult to select the proper types of light sources and equipment because of the wide variety available. For this reason, it is well to review the function of light in show windows, and some of the more important sound principles and practices involved in show window lighting.

Some of the important requisites of show window lighting are given below. It must—

1. Attract attention.
2. Create or increase the desire to buy.
3. Direct the light to the display area efficiently.
4. Provide light of good color quality suitable for the merchandise displayed.
5. Be inconspicuous by concealing light sources and equipment from view of the passers-by.
6. Focus attention on the display area.

In this age of rapid transportation, and less leisure on the part of shoppers, high intensity lighting is desirable in show windows. It may be used to attract attention of passers-by from a distance, and to enable quick vision for those who slow down or stop to view the display. Color may also be employed to provide a high attracting power.

The use of high intensities in lighting displays should not be confused with glare. The lighting should be well diffused over the entire display area and the display line lighted to a fairly uniform intensity. Features in the display may then be highlighted to a still higher intensity in order to focus attention to the feature. Through the use of well designed attractive displays and comfortable, uniform intensities of lighting without glare, much can be done to sell the prospective customer viewing the display at his own leisure from the sidewalk.

Show windows of today are of two general types. The first is the elaborate type which is in effect a stage. Many department stores and some specialty shops feature such show windows, on which the lighting result is changed with each new display. Lighting equipment should be provided for such windows which will provide wide flexibility in lighting effects, to meet the demands of the decorator and assist in creating unusual decorative effects.

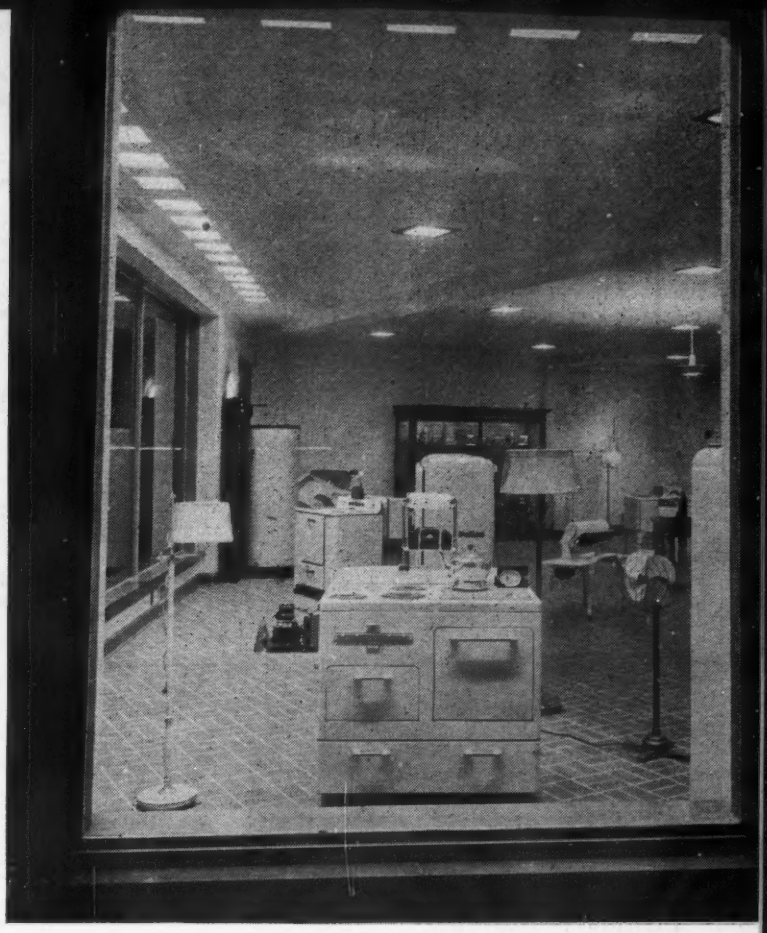
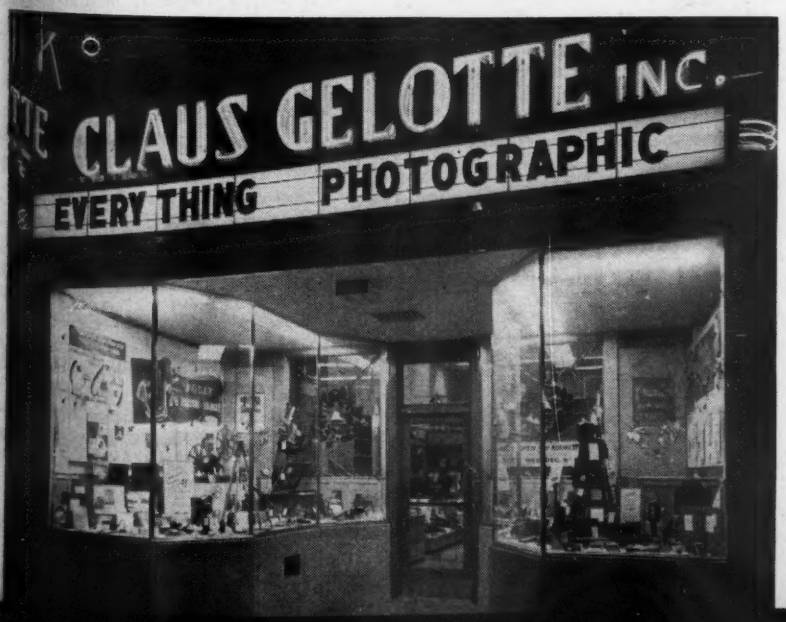


FIG. 4—Holophane lens plates recessed flush in ceiling provide high intensity at window line without glare in open-back display area.

FIG. 3—Kodak store in Boston uses fluorescent lamps and diffuse reflectors to light deep windows. Valance or louvers to shield lamps would improve this installation.



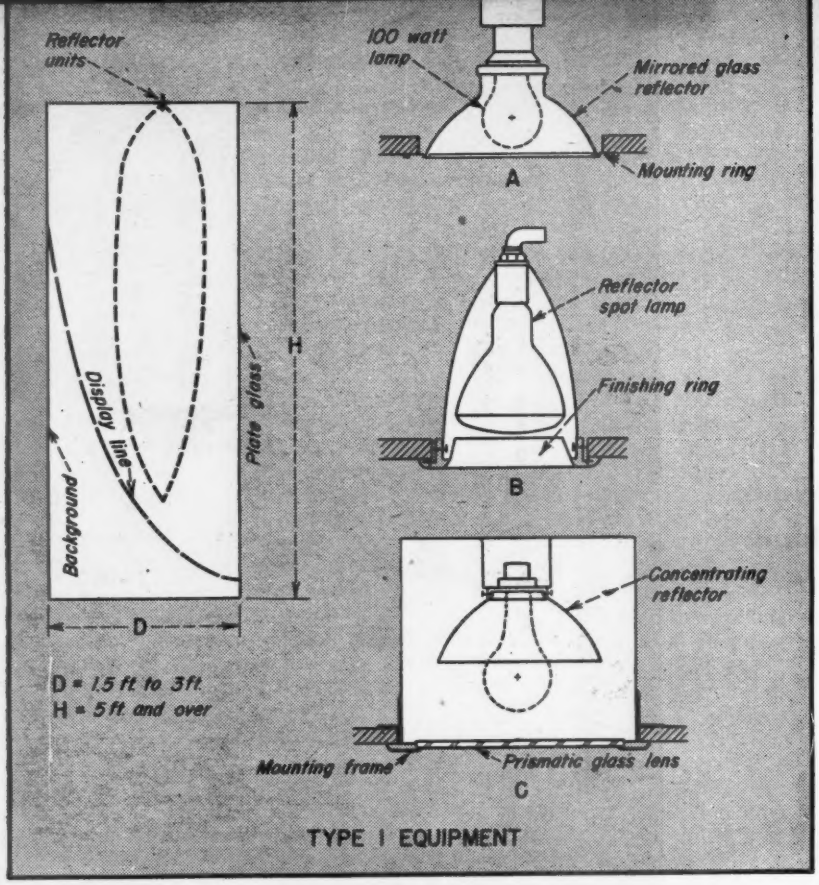


FIG. 5—Concentrating type reflectors provide high intensity lighting efficiently in shallow type show windows. (A) Silver mirrored glass reflector recessed. (B) Reflector spot lamp installed in recessed metal housing. (C) Prismatic glass lens box or trough set flush.

TABLE I. CLASSIFICATION OF REFLECTORS AND EQUIPMENT

Type	Beam	Distribution	Description
1	Narrow	Concentrating	Individual unit
2	Medium	Semi-concentrating	Individual unit
3	Wide	Distributing	Individual unit
4	Narrow	Concentrating	Adj. reflector spot lamp
5	Wide	Distributing	Adj. reflector flood lamp
6	Narrow	Concentrating	Lens spotlight
7	Wide	Distributing	Lens floodlight
8			Louvers, shields
9			Color assessories
10			Proscenium or side strips
11	Wide	Distributing	Footlights
12			Decorative background lighting

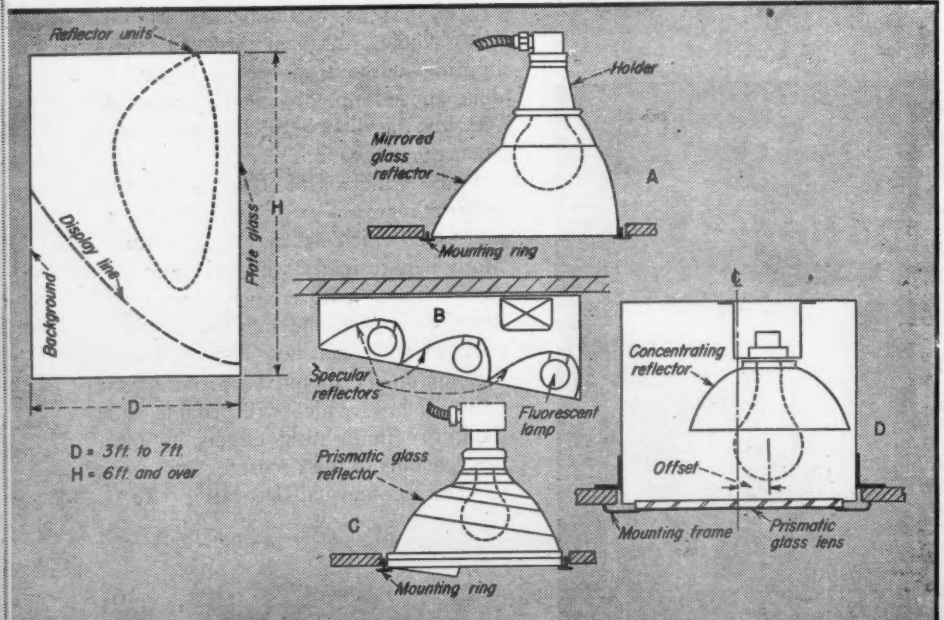


FIG. 6—Medium depth show windows are lighted efficiently with semi-concentrating type reflectors having asymmetric light distribution. (A) Recessed silver mirrored glass reflector. (B) Fluorescent lamp reflector unit with specular asymmetric reflectors. (C) Prismatic glass reflector and shield recessed. (D) Prismatic glass lens box or trough with lamp offset for asymmetric distribution.

The second type window is more general, and requires general illumination of fairly uniform intensity on the display line. These windows should be provided with color accessories and spotlights to supplement the general lighting. This will provide considerable flexibility in lighting result, enabling the decorator to compete with neighboring merchants' windows and other lighted attractions such as theatre marquees, illuminated signs, street lighting, etc.

Show windows vary considerably in size, shape, and general construction. They may have closed backgrounds, or be open to the store interior. They may have a separate furred ceiling, or be open to the store ceiling. They may be shallow or deep, from plate-glass to the background. These variations necessitate the use of different types of equipment to provide the proper lighting result efficiently. The various types of reflectors and equipment, including accessories, have been classified according to beam spread and light distribution in Table I. Reflector units should be chosen which will provide the maximum amount of light on the display line for each window. Accessories such as spotlights, louvers, color frames and color media, should be added to meet the flexibility in display which will be required for the type merchandise involved.

Table II classifies show windows as to size, ceiling or mounting height for equipment, and as to type of background. Types of lighting equipment are listed in Table II which are suitable for varying size windows, using type designations from Table I.

Type 1 reflectors are described in Table I as having a narrow beam. Fig. 5 shows a typical distribution curve for narrow beam reflectors and three

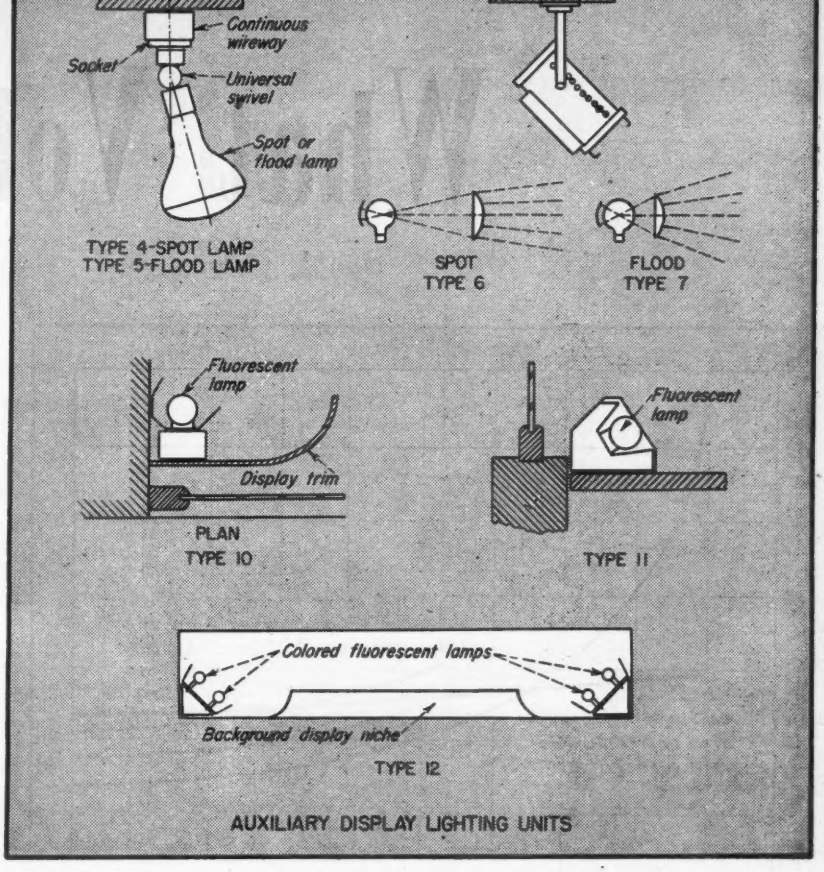


FIG. 7—Incandescent reflector spot or flood lamps with adjustable swivel mounting (Types 4 and 5) installed on wireway. Lens spot unit (Types 6 and 7). Proscenium reflector with fluorescent lamp (Type 10). Fluorescent footlight (Type 11). Background effect lighting with cold cathode colored fluorescent (Type 12).

types of equipment which can be used to produce this distribution. The equipment is shown recessed flush in a furred ceiling, but may also be mounted on the ceiling surface, or attached to a transom.

A distribution curve and typical units are also shown for Types 2 and 3 reflectors in Figs. 6 and 8 respectively. Auxiliary display lighting units are shown in Fig. 7.

Incandescent light sources are preferred for window lighting, since the color quality of the white light is excellent for most displays, and more accurate control of the light is possible. In walking down main street in almost any village, town or city, and observing the lighting equipment used to light show windows, it is possible to see practically all types of reflectors, light sources, spotlights, and other window lighting devices in use. Careful analysis of these installations will provide first hand information on the advantages of each type. Fluorescent lamps and diffuse type reflectors have already been used to light many show windows, regardless of the size or shape of the windows. Because of the inherent wide angle distribution of light from these units, the resultant lighting effect is not usually efficient. Such units also create considerable glare for prospective customers when standing near the window front unless carefully louvered or otherwise shielded. The top area of the windows is brightly lighted, but the intensity on the display line is usually too low for effective window lighting. When fluorescent units are used for medium size windows (Fig. 6-B), reflecting surfaces should be specular to provide as much control of light as possible. For large show windows where the depth of the window is ap-

[Continued on page 144]

TABLE II. LIGHTING EQUIPMENT FOR SPECIFIC TYPES OF SHOW WINDOWS

Depth	Height	Background	Types of Equipment*
1 ft. 6 in. to 3 ft.	2 ft. to 5 ft.	closed	2-4-6-9-12
		open	2-4-6-8-9
	5 ft. and over	closed	1-4-6-9-12
		open	1-4-6-8-9
3 ft. to 7 ft.	4 ft. to 6 ft.	closed	3-4-5-6-7-9-12
		open	2-4-6-8-9
	6 ft. and over	closed	1-2-3-4-5-6-7-9-10-12
		open	1-2-4-6-8-9
7 ft. and over	5 ft. to 7 ft.	closed	3-4-5-6-7-9-10-11-12
		open	2-4-6-8-9
	7 ft. and over	closed	2-3-4-5-6-7-9-10-11-12
		open	2-4-6-8-9

* From Table I.

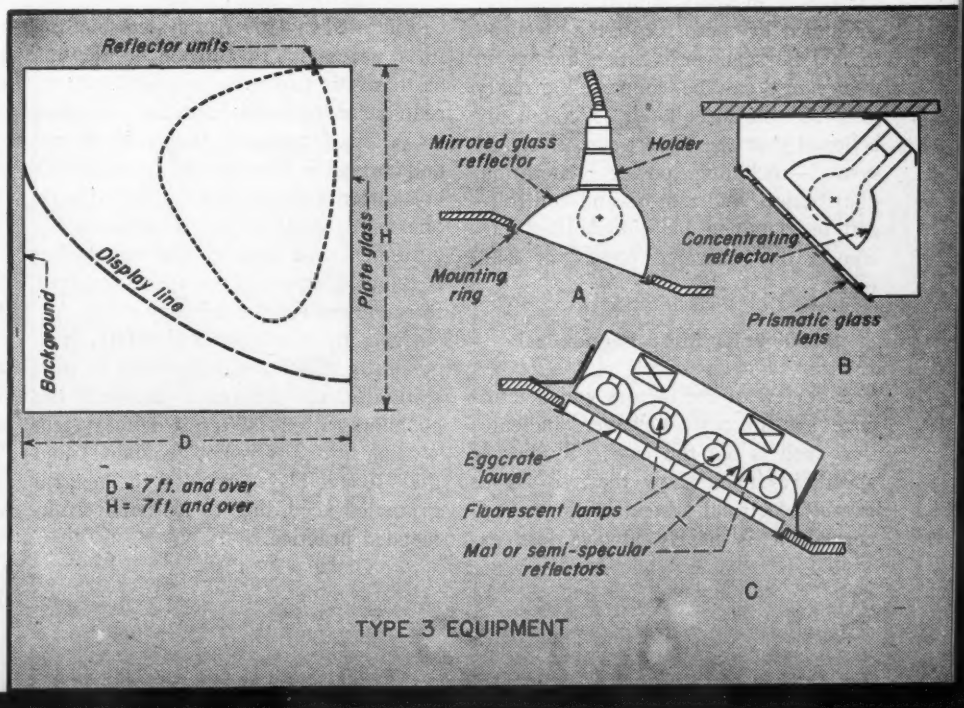


FIG. 8—Wide angle diffuse reflectors are required to evenly light the display line in deep windows. (A) Flush silver mirrored glass reflector. (B) Flush prismatic glass lens installed at angle. (C) Fluorescent unit installed behind flush louver set at angle. Equipment properly concealed and louvered may also be installed over the rear portion of deep windows to provide efficient background lighting.

What Voltage for I

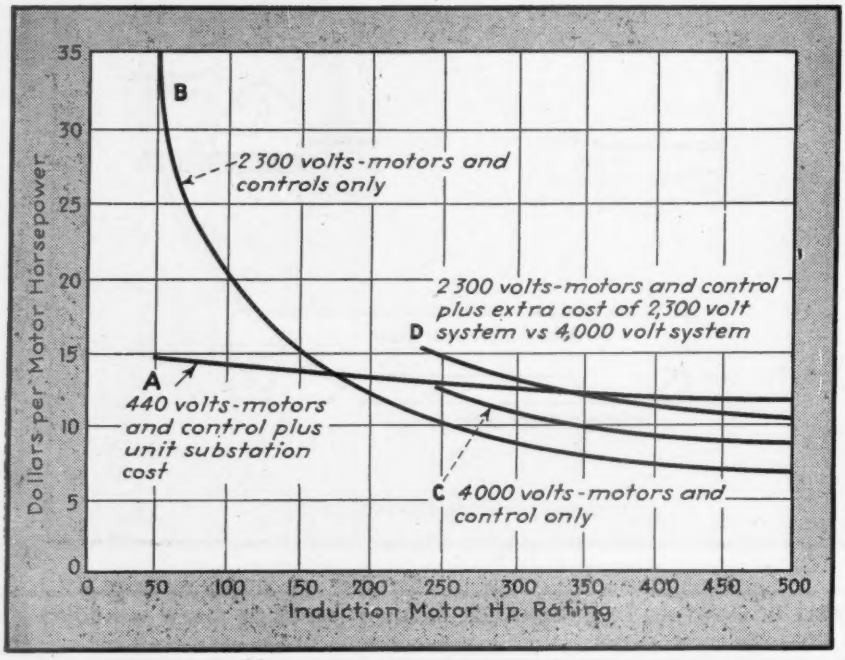


Fig. 1—Cost of motors, control, wiring and transformers is included in this comparison of 2400 volt distribution system versus 4160 volt system. The curves are plotted in dollars per high-voltage motor horsepower.

THE $64 question on plant distribution concerns system voltage. For a new, medium-size industrial plant, or an existing plant being reconverted, modernized, or expanded, which is the most economical—2400 volts or 4160 volts?

Many operators will say 2400 volts, and for an apparently logical reason. A sizable percentage of the total electric power in many industrial plants is consumed by motors ranging from 40 to 500 horsepower. Since motors in that range can be connected directly to 2400 volt circuits, it is commonly believed that the lowest-cost electrical system—including power generation, distribution, and motors and control—can be obtained by distributing purchased or generated power at 2400 volts.

4160 Volts Most Economical

A review of the factors which influence system cost, however, indicates that such is not the case. Studies of specific systems show that, so far as *overall* electrical system costs are concerned, it is nearly always less expensive to use 4160 volts primary or generation voltage rather than 2400 volts, and to operate most motors of 200 hp. and less on 460 or 575 volt circuits. This conclusion is based on the data shown in Fig. 1.

The 4160 volt system offers many important advantages other than lower cost. Short-circuit current bottlenecks are not reached as readily; higher system short-circuit kva. can be tolerated in 4160 volt systems before it is necessary to introduce reactors or to resort to special combinations to reduce short-circuit currents. In general, fewer primary feeder positions and less cable are required for the 4160 volt distribution system compared with one using 2400 volts. The space requirements for housing the switchgear is reduced, and also the space required for conduits for the primary cable.

From the standpoint of safety, it is generally concluded that there is substantially no difference between the commonly used 2400 volt delta system (which normally is not grounded) and the 4160 volt system with the neutral grounded according to modern recommended practice.

To select the most desirable primary or generation voltage would necessitate comparing all voltages below 15 kv. This would be rather involved and is beyond the scope of this article. The main consideration in many medium-size industrial plants is whether to use a 2400 or a 4160 volt primary distribution system. The remainder of this discussion is limited to an economic comparison of these two voltages.

Standard Primary Voltages

In some areas 4800 volts is the standard primary voltage. The basic factors presented here are not substantially altered whether the voltage is 4160 or 4800 volts. Since 4160 volts is far more common, it will be used as a basis of comparison.

Adequate Interrupting Capacity

There has been a tendency to totally disregard short-circuit current interrupting duty imposed on motor starters for short circuits which may occur on the load side of the motor starter. Adequate interrupting capacity is desirable in the motor starters to safely and quickly open these short-circuit currents. When a fault occurs on the load side of the motor starter and the latter does not have adequate interrupting capacity, it may fail and endanger nearby personnel and property. It may also cause the feeder circuit breaker to be tripped out, thus dropping service over a large area of the plant and, as a consequence, substantially affect production. From this it can be seen that it is equally as important to select motor starters with adequate short-circuit interrupting rating as it is to select feeder circuit breakers with adequate interrupting rating. Therefore, only modern combination motor starters are considered in this basic comparison.

And since stardard squirrel-cage induction motors are by far the most common, and to make this study as representative as possible, these motors have been considered as a basis of comparison. The curves in Fig. 1 are plotted for 1800 rpm. motors.

When comparing 440 volt motors to

Industrial Plants

Wiring and equipment costs, which include motors, control, switchgear and transformers, are compared for 2400 and 4160 distribution voltages.

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motors operating directly at the primary distribution voltage (i.e., 2400 or 4160 volts), the installed price of a step-down substation must be included with the 440-volt motors and control. This substation is included at $4.00 per horsepower. This figure is based on the installed price of a unit substation consisting of a transformer and one secondary breaker. It is assumed that, due to diversity, one kva. of transformer capacity will care for 1⅔ hp. of motors. Since branch circuits to 440 volt motors usually require larger cables than do 2300 or 4000 volt motors, 50 cents per horsepower was included in curve A to cover the cost of the larger 440 volt cables. The one-line diagram of the circuit elements for 440 or 550 volt motors, operating from 2400 or 4160 volt primary systems, is shown in Fig. 2. The cost of the low-voltage motors, control, and the step-down unit substation is plotted as a function of motor horsepower rating in curve A, Fig. 1.

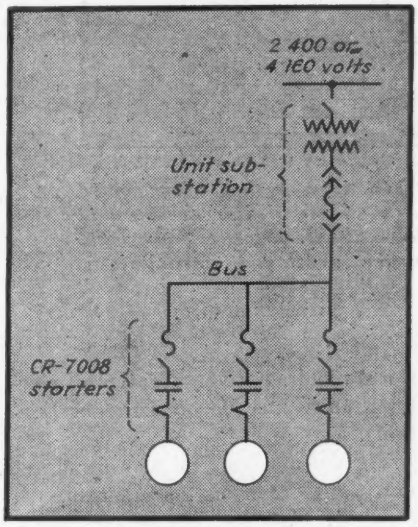


Fig. 2—Typical layout for 440 volt motors, 40 hp. and larger.

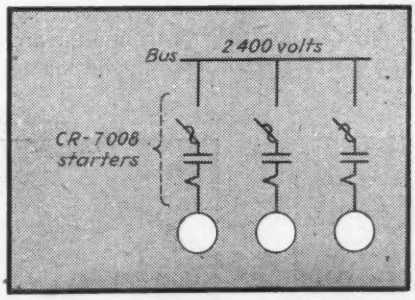


Fig. 3—Typical layout for 2400 volt motors, 40 hp. and larger.

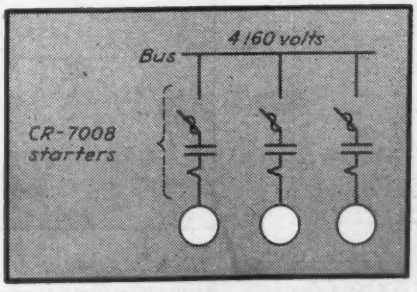


Fig. 4—Typical layout for 4000 volt motors, 40 hp. and larger.

Motors Operating At Primary Voltage

When selecting the primary voltage of the power distribution system, it is necessary to consider more than just the prices of the motors and control which operate at primary voltage, i.e., at 2400 or 4160 volts. The approximate prices of high-voltage motors and control only, Figs. 3 and 4, are plotted in Fig. 1 as curves B and C.

The cost of the primary system must be considered as well as the cost of the motors and control if the lowest overall electrical system cost is to be obtained. Thus, in deriving the primary system cost, the 2400 volt and the 4160 volt systems must be considered separately because of the difference in motor costs. That is, 2300 volt motors will be used on the 2400 volt lines, and 4000 volt motors on the 4160 volt lines.

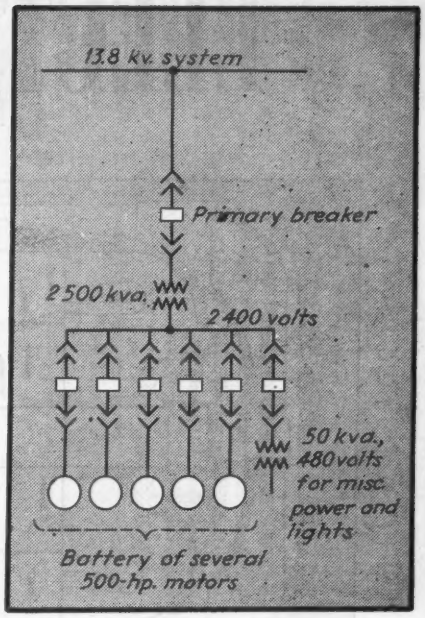


Fig. 5—Typical layout for pumping station.

Main Substation Costs

In industrial plants with a total demand of a few thousand kva., the primary power system (i.e., the generating plant or main step-down substation from the utility system) and the primary switchgear and cable will cost about $2.00 more per kva. for 2400 volt primary voltage than for 4160 volt primary voltage. This cost differential will increase to about $4.00 or $5.00 more per kva. for systems about 10,000 kva. and larger.

Therefore, if a 2400 volt system is arbitrarily chosen in place of a 4160 volt system, the *extra cost* of the entire 2400 volt over the entire 4160 volt distribution system must be added to the cost of the 2300 volt motors and control, and then compared with the cost of 4000 volt motors and control for those motors which operate at primary voltage.

This comparison can be made by referring to curves C and D in Fig. 1. These curves show that the 2300 volt motors and control, plus the extra cost of the 2400 volt power system, are more expensive than 4000 volt motors and control. For the general case, then, curves C and D, ***and not curves B and C, should*** be used when selecting the primary system voltage for plants where a sizable portion of the total connected load consists of motors larger than about 200 hp.

[Continued on Page 125]

ELECTRICAL EQUIPMENT

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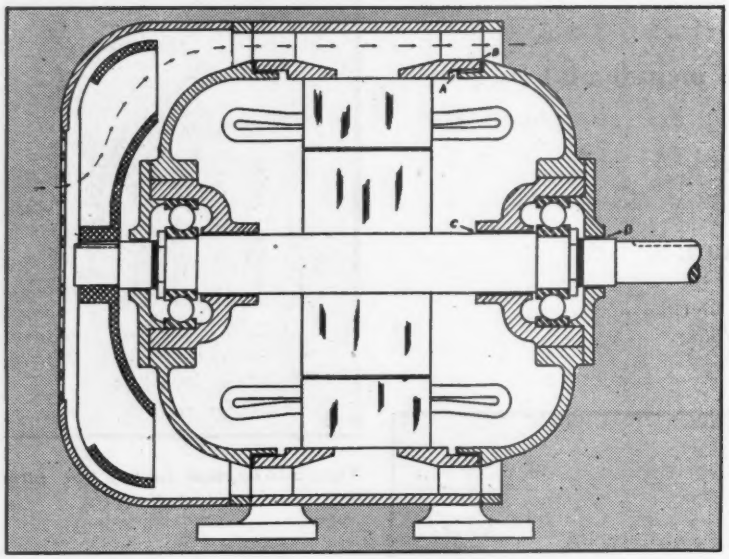


***FIG. 1—EXPLOSION-PROOF MOTOR** cross-section (fan cooled unit) shows points A, B, C, D, etc. that must provide overlap and close fit to confine internal explosions. Enclosing case must withstand four times maximum pressure developed during tests.*

IN the days before the development and commercial introduction of explosion-proof and dust-tight electrical equipment for use in hazardous locations, the inspection authorities and the insurance underwriters restricted the use of electrical motors and other equipment having arcing or sparking contacts. Safety considerations prohibited the use of such equipment in hazardous areas, and the laws of many states required the segregation of electrical apparatus in nonhazardous locations.

The demand for explosion-proof and dust-tight electrical equipment increased rapidly with the growing use of electrical power and with the introduction of new manufacturing processes that released flammable gases and vapors, or combustible dusts, into the air. The early 1920's marked the beginning of a period during which the manufacturers have expended much time and effort in the development of electrical equipment that will satisfy the exacting requirements of safety and, at the same time, be practical and efficient at a reasonable cost to the user. Prior to the beginning of World War II, the manufacturers had developed a practically complete line of this type of equipment. This enabled them to cope with the accelerated demand resulting from our war production program.

Concurrent with the development of equipment for safe use in hazardous areas, it was of increasing importance to define "hazardous locations" more clearly. This function was fulfilled by the National Electrical Code, Article 500 of which defines hazardous locations and establishes four classifications in order that the inspection authorities enforcing the Code may determine the need of explosion-proof or dust-tight equipment in any area. The hazardous location equipment listed by Underwriters' Laboratories is intended for use in Class I or Class II locations, and the present discussion will be confined to those two classifications.

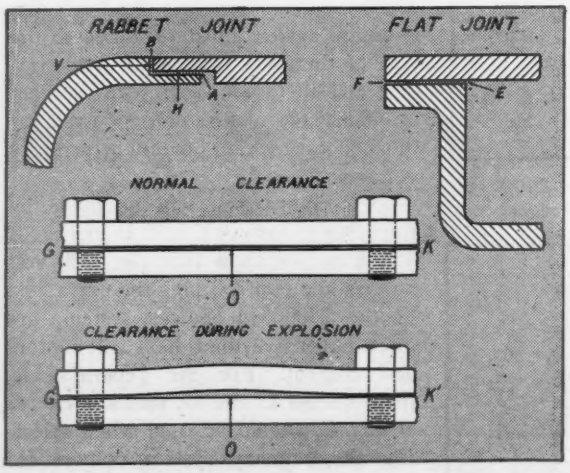


***FIG. 2—EXPLOSION-PROOF JOINTS** are of the rabbet and flat type (used in motor of Fig. 1). Carefully machined surfaces and heavily bolted assemblies are effective in arresting flame from internal explosions.*

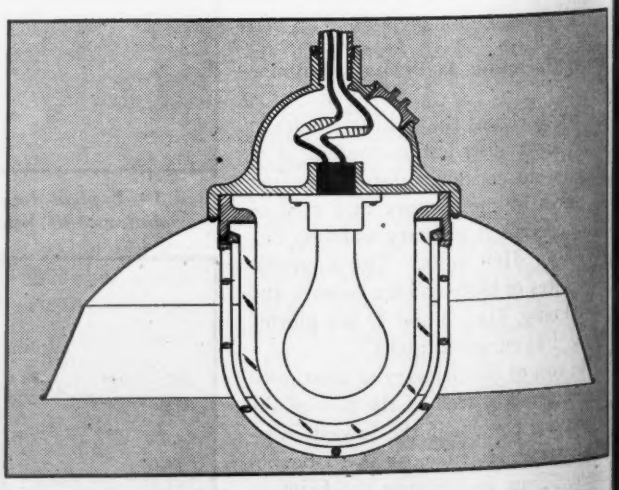


***FIG. 3—EXPLOSION-PROOF FIXTURE** cross-section shows heavy glass and metal parts with threaded or close-fitting joints to prevent flame propagation from interior under explosion conditions. Fixtures must withstand four times top pressures.*

for HAZARDOUS LOCATIONS

What makes electrical equipment safe for use in hazardous locations? Here is an insight into the research, design and testing technique that back up the U. L. Label for approval.

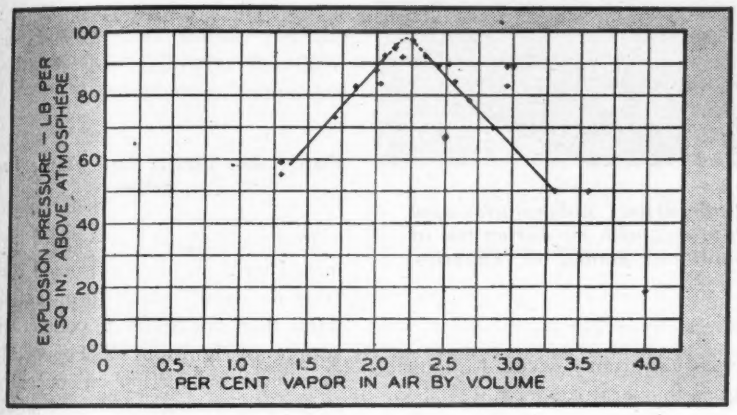


FIG. 4—EXPLOSION PRESSURE CURVES of gasoline vapor in air.

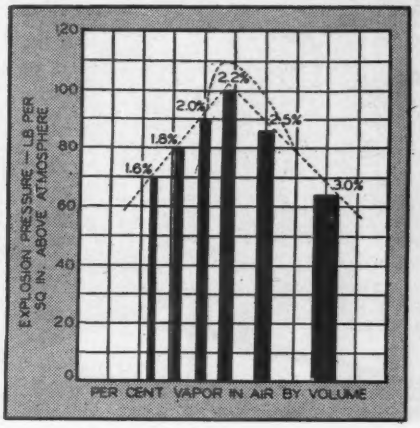


FIG. 5—EXPLOSION PRESSURES of gasoline vapor in air. Width of column represents, roughly, the duration of the flame.

Class I and Class II hazardous locations are defined by the Code as follows:

"*Class I locations* are those in which flammable volatile liquids, highly flammable gases, mixtures or other highly flammable substances are manufactured, used, handled, or stored in other than their original containers.

"*Class II locations* are those in which (1) combustible dust is thrown, or likely to be thrown, into suspension in the air in sufficient quantities to produce explosive mixtures, or (2) those where it is impracticable to prevent such combustible dust from collecting in such quantities on or in motors, lamps, or other electrical devices that are likely to become overheated because normal radiation is prevented."

If a flammable vapor or gas is present or likely to be present in the atmosphere, such area is therefore a Class I location. Similarly, if combustible dust is present or likely to be present in the atmosphere in dangerous amounts or collects in dangerous amounts on electrical equipments, such area is a Class II location. The responsibility of determining the existence and extent of the hazardous area rests with the authority enforcing the Code. As it often requires careful inspection work to determine the extent of the hazardous area in a plant, it is evident that all installations cannot be definitely covered by rules. *Article 500 leaves much to the decision of the inspection authority.*

The National Electrical Code recognizes that the hazards of an area may not be the same for all types of flammable gases and vapors, or for all types of combustible dusts. By a fine-print note at the start of Article 500, the Code shows sub-classifications within the Class I and Class II groupings. These sub-classifications, which are used by Underwriters' Laboratories for the listing of electrical equipments, are:

Class I

Group A—Atmospheres containing acetylene.

Group B—Atmospheres containing hydrogen or gases or vapors of equivalent hazards such as manufactured gas.

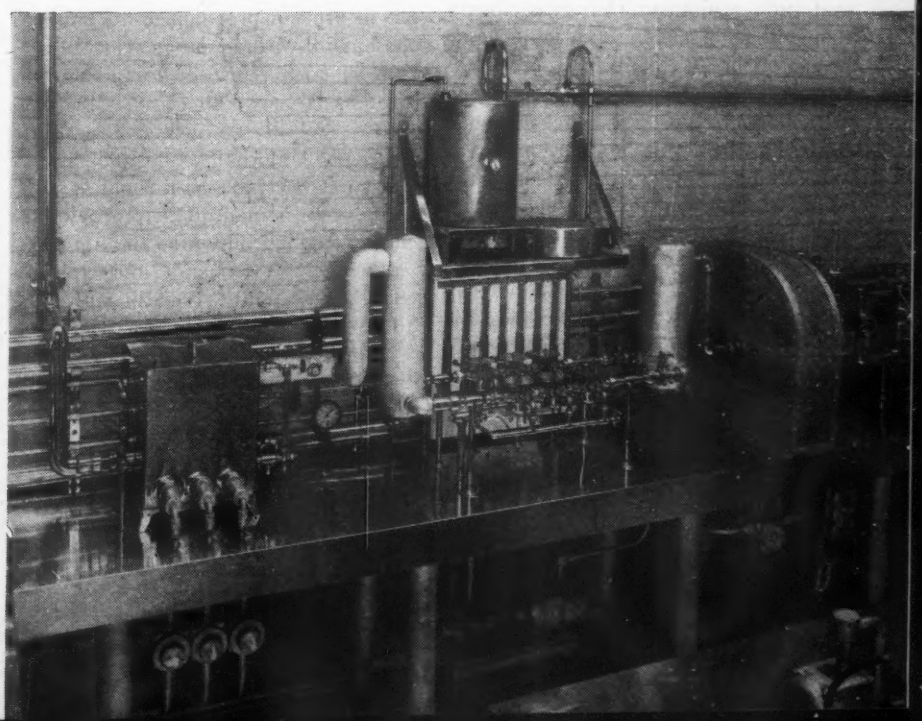


FIG. 6—CLASS 1 EQUIPMENT TESTS are made in explosive vapor-air mixtures produced by this carburetor system at the Underwriters' Laboratories.

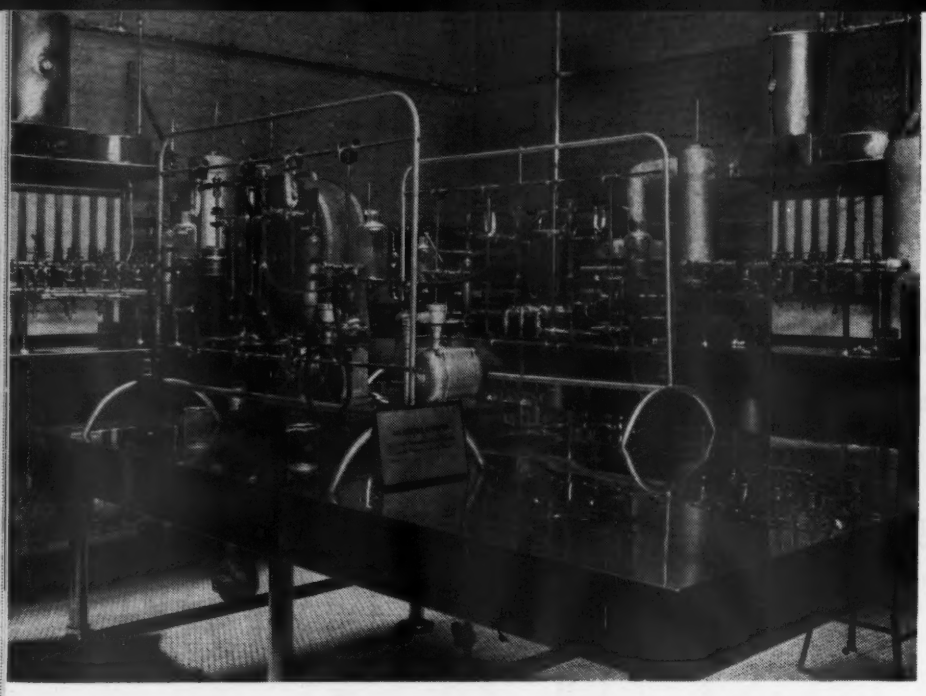


FIG. 7—GAS ANALYSIS APPARATUS at Underwriters' Laboratories used to check explosive mixtures of gasoline, ether, etc., with air during test of explosion-proof electrical equipment for munitions plants, oil refineries, hospitals, and other hazardous locations.

Group C—Atmospheres containing ethyl-ether vapors ethylene or cyclopropane.

Group D—Atmospheres containing gasoline, petroleum, naphtha, alcohol, acetone, benzol, lacquer solvent vapors and natural gas.

Class II

Group E—Atmospheres containing metal dusts.

Group F—Atmospheres containing carbon, coal or coke dust.

Group G—Atmospheres containing grain dust.

Class I Type Construction

The term "explosion-proof" indicates that such equipment has an enclosure that will withstand internal explosions of gas or vapor-air mixtures. In other words, the explosions will be confined without bursting the enclosure or loosening the joints, and the propagation of flames will be arrested by the close-fitting, metal-to-metal joints that have *sufficient overlap to cool the hot gases that vent to the outside.* The enclosure must have these characteristics because it is practically impossible to prevent the entrance of explosive vapors. *Actual tests have shown that the gases and vapors enter the enclosures even under normal changes of temperature. Hence, the term "vapor-proof" is misleading when used with reference to motors, lighting fixtures, and other equipments intended for use in Class I hazardous locations.*

Explosion-proof devices also must be designed to operate under full load conditions without developing temperatures above the ignition temperature of the flammable gas or vapor in which they are intended to be used. The laboratory test work for such equipment must be supplemented by a careful investigation of the construction details. Compliance with the construction requirements is a prerequisite to the listing of explosion-proof equipments that are submitted to Underwriters' Laboratories, Inc.

Figure 1 shows a cross-section view of a fan-cooled explosion-proof motor. The typical joints shown at A, B, C, and D, must be maintained sufficiently close-fitting and with adequate overlap to prevent propagation of flame to the outside of the motor enclosure.

A close-up view of joints between sections is shown in Fig. 2. The section G'-K' illustrates the effect produced by internal explosions as the pressures are relieved through a joint. If the joint is inadequate to provide the proper cooling action as the hot gases are vented to the outside, and explosion may be initiated in the vapor-air mixture surrounding the motor.

Figure 3 shows the cross-section of one type of explosion-proof electric fixture which utilizes metal-to-metal or metal-to-glass joints to prevent propagation of flames from the interior of the fixture during the series of 30 or more explosion tests. Metal-covered gaskets between metal and glass parts must be mechanically attached to the glass. Such gaskets are used only at joints that will not be disturbed in relamping.

It is apparent that the type of wiring used in Class I locations is of importance in order not to nullify the safety obtained by the use of explosion-proof equipment. For this reason the National Electrical Code requires that rigid conduit with explosion-proof joints shall be employed as the wiring method. *Joints in approved conduit made up with five full threads are recognized as explosion-proof.*

Flammable Limits And Flame Propagation

Flammable gases or vapors may be mixed with air in a *minimum* concentration below which propagation of flame does not occur on contact with a source of ignition. There is also a *maximum* proportion or concentration above which combustion does not occur. These minimum and maximum concentrations of the gas or vapor in air are known as the "lower" and "higher" flammable or explosive limits, and are usually expressed in terms of percentage of gas or vapor in air by volume. Within the explosive range (between the "low" and "high" limits) there is a concentration, or "richness" of the mixture, that will produce the most intense combustion or explosion of which the particular gas or vapor is capable.

The flammable limits are influenced by the initial temperature, the dimen-



FIG. 8—TESTING AN EXPLOSION-PROOF MOTOR. Engineer is removing record card showing internal pressure developed during an explosion inside the motor casing.

sions of the container, the pressure, and in certain cases, by turbulence.

The lower flammable limit of gasoline vapor is approximately 1.4 percent, the upper limit is about 6 percent, and by difference the flammable or explosive range is 4.6 This is shown graphically in Fig. 4.

Research tests conducted at Underwriters' Laboratories under the supervision of A. H. Nuckolls, Chemical Engineer, have shown that throughout the explosive range of gasoline there are certain zones of concentration that are most likely to cause failure in the testing of explosion-proof equipment. These concentrations are used in the explosion tests of Class I equipment. The most intense explosion occurs at about 2.25 percent gasoline vapor in air by volume (see Fig. 5). The maximum effects of escape or propagation of flame through joints and similar openings, however, does not coincide in all cases with the concentration that produces the most intense explosion. Hence, additional tests are made to check these maximum effects.

Under conditions of confinement, the explosion of vapor-air mixture produces a pressure rise that depends upon the "combustion intensity" and the concentration of the mixture, the dimensions and strength of the enclosure, and the turbulence of the mixture. Tests in a nickel steel bomb of 70 cu. in. free volume show gasoline vapor-air explosion pressures of 100 lb per sq. in., while acetylene give a maximum pressure of 250 lb per sq. in. In the tests of explosion-proof motors, where the moving rotor and internal fans produce turbulence to a high degree, *the internal explosion pressure is often more than twice as high with the motor running as it is with the motor idle at the time the explosive mixture is fired.*

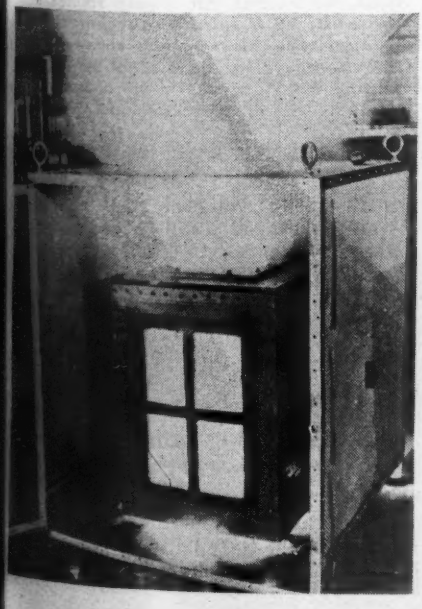


FIG. 9—SWITCH BLOWS UP during test. 1 poorly designed "explosion-proof" (Class 1) switch produced these fireworks during a test at Underwriters' Laboratories.

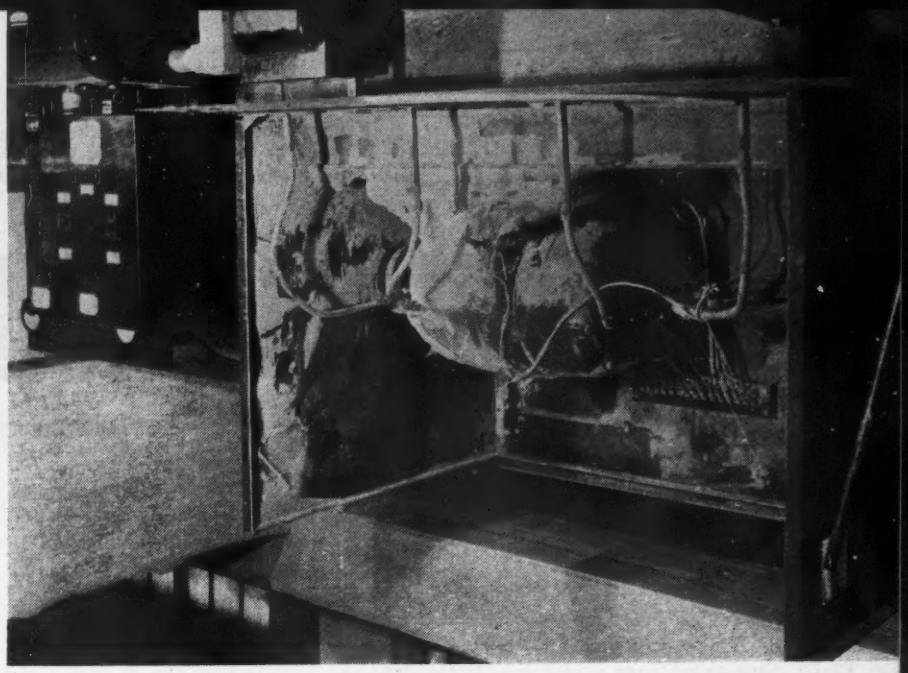


FIG. 10—COVERED WITH DUST after test at Underwriters' Laboratories, this dust-tight motor awaits closer inspection. Tests for use in atmospheres of explosive dusts represent months and years of actual factory use.

Tests Of Class I Equipment

From this discussion it will be seen that accurate control and determination of the concentration of the gas or vapor in the mixture with air is necessary in order to conduct adequate and reproducible tests of explosion-proof equipment. It is also necessary to have a sufficiently large supply of explosive mixture of predetermined and constant concentration quickly to replace the original air within the enclosure of the device undergoing tests. In tests of explosion-proof equipment at Underwriters' Laboratories, this is accomplished by special carburetor systems (Fig. 6). Each system consists of needle valves and mixing chambers and a rotary fan. The needle valves control the rate of flow of liquid from a constant level supply tank to the mixing chambers, in which it is vaporized by the passage of the air current produced by the rotary fan driven at constant speed.

Determination of the concentration of the gas or vapor in the explosive mixture are made by means of analytical tests, the method used depending upon the nature of the gas or vapor. In the testing of gasoline vapor-air mixtures the sample is collected in a glass tube and, after removal of moisture, is subjected to a temperature of −185° C (−301° F) by means of liquid air. A vacuum pump is used to remove the air from the sample and the partial pressure of the gasoline vapor is measured. The analytical equipment is shown on the table in the center of Fig. 7.

Explosion-proof equipment undergoing tests, for example and electric motor, is first examined to determine that it complies with the construction requirements, and that there are no weaknesses in strength of parts as shown by measurements and calculations. The motor is then prepared for explosion tests by drilling and tapping threaded openings in the casing for inlet and outlet connection to the carburetor system, for spark plugs for ignition of the explosive vapor-air mixture within the casing, and for connection of pressure-recording devices. The motor is installed in a test box (Fig. 8) having windows for observation of the sample during tests. The test box is also provided with inlet and outlet connections to the carburetor system so that both the motor and the surrounding atmosphere within the test box can be filled with the explosive vapor-air mixture for the explosion test. Sand bags or wire screens are used to safeguard against the danger from flying parts in case of rupture of the sample from the internal explosion.

For a Class I, Group D test, the carburetor system is adjusted to produce a gasoline vapor-air mixture of a predetermined concentration, and this mixture is introduced into the enclos-

(Continued on Page 137)

BRIEF ARTICLES about practical methods of installation and maintaining electrical wiring and equipment and up-to-date estimating and office practices. Readers are invited to contribute items from their experience to this department. All articles used will be paid for.

PRACTICAL METHODS

ELECTROSTATIC PAINTING OF ROCKET FINS

INDUSTRIAL

The Navy 5-inch rocket is a sinister appearing device just to look at it on the loading dock or out in an Ordnance Plant. Suspended from a Navy fighter plane or dive bomber it looks every part the deadly weapon that it is from the tip of its business-like nose to the end of its well designed fin.

Thousands of these fins are being made in the metal fabricating plant of the Russakov Can Company in Chicago. After stamping, forming, welding and inspection operations are completed, the fins are assembled on a conveyor line for a dual coating of aluminum paint which preserves them from deterioration.

The very physical nature of these fins presented a problem in painting. Every part of the unit, both inside and outside, had to be well covered with the aluminum paint. To speed up production and increase the quality of the painting job, Russakov installed the Ransburg Electrostatic Paint Spraying Process. One salient feature of this process is the fact that the paint, through electrostatic attraction, reaches in, overlaps and "wraps-around" all contours of the work. Thus, while traveling at approximately 10 feet per minute on 18-inch centers on the conveyor, the fins are completely coated while in the relatively small spray zone of the booth. Only one set of automatic spray guns per booth is necessary.

One of the pertinent problems overcome was the design of a fixture or work holder to so suspend each fin from the conveyor line while in the spraying zone that all surfaces would receive an adequate paint coating with a minimum of time and delay. This was accomplished by the fixture design illustrated in Fig. 1. By means of the spinner attachment illustrated, the fin is slowly rotated while it travels at 10 feet per minute through the electrostatic spray.

There are two spray booths at the plant. One is used to apply the prime coat to the fins which are then conveyed into an adjoining bank of infra-red lamps. Emerging from the lamps, the conveyor takes the fins to the second spray booth where the final coat of paint is applied. From here they go into a second bank of infra-red lamps for final drying before shipment. Both booths draw paint from the same paint tank, are operated from the same control panel (see photograph) and obtain power for the electrostatic field from the same source.

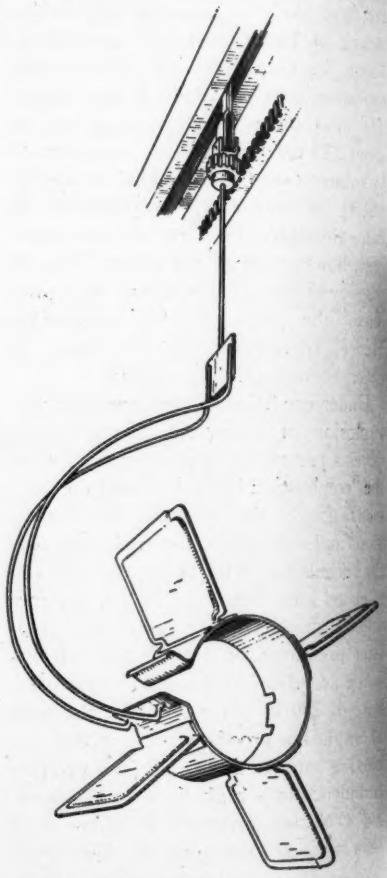
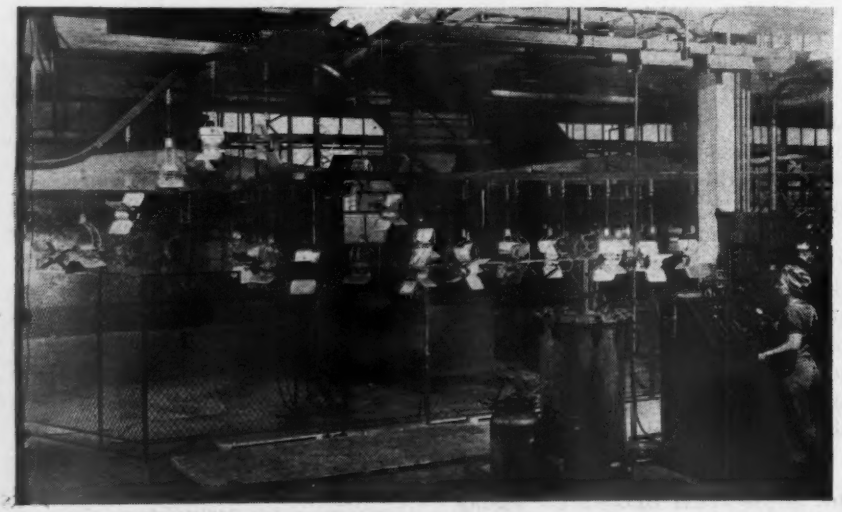


FIG. 1—Special fixture designed to hold the rocket fin slowly rotates the unit, by a spinner attachment, through the electrostatic spray in the booth. An even coating of paint, both inside and outside, results.



Rocket fins go through electrostatic paint spray lines at the Russakov Can Company, Chicago. Continuous conveyor line takes fins through prime coat spray booth into adjoining infra-red tunnel, then through second spray booth and infra-red tunnel for final drying before shipment.

Before the installation of the electrostatic process, the old hand spray method was used. By this method a maximum of only 15 fins could be coated per gallon of paint (both coats). Under the electrostatic process, 23 fins per gallon of paint (both coats) are coated—effecting a minimum saving of 33⅓ percent in coating material. Now, about 100 to 120 gallons of paint are used per an eight-hour period.

Time saving is another important feature of the installation. Fins are now being processed at the rate of

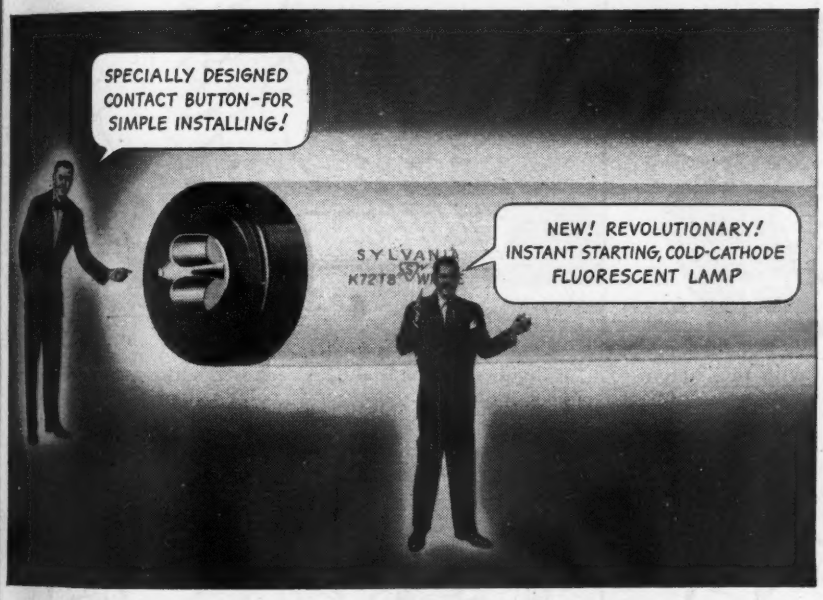
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SYLVANIA NEWS
CONTRACTOR EDITION

NOV. *Published by* SYLVANIA ELECTRIC PRODUCTS INC., Salem, Mass. 1945

FIRST INSTANT START, COLD-CATHODE FLUORESCENT (K) LAMPS PRODUCT OF SYLVANIA RESEARCH

This Long-Lasting, Revolutionary Type of Lighting Helps Cut Maintenance Costs



Newest of Sylvania Electric's developments—the K Fluorescent Lamp—instant starting, cold-cathode, long-lasting.

Lamp Designation	K96T8	K72T8
Nominal Lamp Length*	96"	72"
Bulb Diameter	T-8	T-8
Lamp Current, Milliamperes	120	120
Life Expectancy, Hours	10,000	10,000

*Measured from back to back of the two lampholders.

The newest of Sylvania Electric's developments—the K Fluorescent Lamp—marks one of the broadest, most revolutionary steps yet made in the lighting field.

Addition of these *cold-cathode* lamps to the regular line of fluorescent products makes Sylvania the first lamp company to offer a *complete* line of fluorescent lighting equipment.

Contractors, in particular, will be interested in the following special advantages of these lamps:

1. Because they will be *instant starting* and will have *a rated life of 10,000 hours—virtually unaffected by the frequency of on and off operation*—they are especially suitable for places where maintenance is either difficult or costly.

2. For further simplification of installation and maintenance, the base of the new lamp has a *specially designed contact pin* made to fit its lampholder (punched with a hole of similar design) in order to prevent lamps that might look like the K lamp from being inserted into the circuit.

These Sylvania K (cold-cathode) fluorescent lamps will be placed on a standard production basis. They will be available early in 1946 through the usual distribution channels, will be made in 72" and 96" lengths of 1-inch (T8) diameter, and will come in the standard white color. Soft white, daylight and a wide variety of other color lamps will be added gradually.

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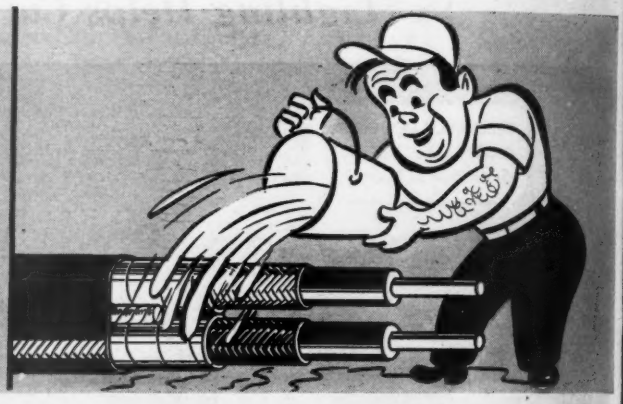
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Individual cotton braid, impregnated with moisture-resisting, flame-retarding compound (color coded for easy identification) and wrapped with folded, moisture-resistant paper.



Conductors laid parallel. Jute rip-cord filler is laid in the interstices. A tinned copper wire is used in place of one jute filler for grounded cable.



Firmly woven cotton braid jacket over all—permanently impregnated with moisture-resistant, flame-retarding compound. A smooth, clean-handling cable—that's *Paraflex!*

● Paranite non-metallic sheathed *Paraflex* Cable is available with or without ground wire —maximum 300 volts to ground or 600 volts between conductors. Specifications on request.

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six per minute—a considerable increase over the former rate. Cleaning time for booths is also materially reduced. Only once a week, preferably on the week-end, is it necessary to clean the booths of the small quantity of over-spray that has accumulated.

This painting line, especially engineered for rocket fin coating, is doing the same efficient job that other electrostatic process installations are accomplishing in numerous war plants throughout the country.

VIBRATION-PROOF CONDUIT CLAMP

INDUSTRIAL

The Glenn L. Martin Company, Baltimore, Md., has developed a new type clamp, particularly adaptable for tube and conduit type installations of all kinds. The development is another step forward in Martin's program to promote ease of maintenance and simplicity of design in the planes which the company builds.

The clamp is shaped after an inverted lateral "s" and is fastened to the wall or frame with an ordinary screw. The tubing to be fastened is placed in the open side of the curve and the clamping ring passes around the back of the base, over the top of the tubing and down the front where it is hooked under the curve at the front of the "s" to form a simple locking device.

The clamping ring can be made of a high grade synthetic rubber or other elastic material. At the present time, the Martin plants are using standard hydraulic seal "o" rings which have been rejected for use as hydraulic seals because of improper tolerances. The rubber ring also serves as a "shock absorber" in eliminating vibration. If it is damaged and necessitates replacement, this can be accomplished without removing the clamp body.

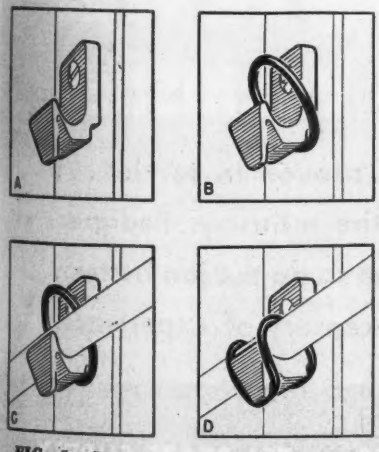


FIG. 1—Metal clamp (A) fastens simply with ordinary screw. To install conduit, clamping ring (B) is put in place, conduit is laid in clamp (C), and clamping ring is then pulled over conduit and slipped into groove (D) in metal clamp.

The clamp proper can be moulded from a fabric base phenol fiber material or fabricated from formed sheet metal in any desired size. The combination results in a clamp which is extremly durable, yet light in weight and attractive.

Now being used in plane installations for fastening hydraulic and pneumatic tubing, wire bundles and electrical conduits, the bodies are moulded in color to follow individual hydraulic or electrical runs.

The clamp is an answer to the "mechanic's prayer" for in addition to needing no tools for installation or removal of objects, the clamps afford other conveniences. There are no loose parts to be lost or broken, and when the clamps are used in a series, any single tube or conduit can be removed without disturbing the others. The clamp also is readily adaptable for bonding.

These clamps can be made in a variety of sizes to meet many clamp problems encountered daily. Their use is in no way restricted to plane production. They could be readily used for other similar industrial purposes, especially where vibration is a factor. Such uses might include fastening cables or conduit in a boat, or to an industrial machine, and similar applications.

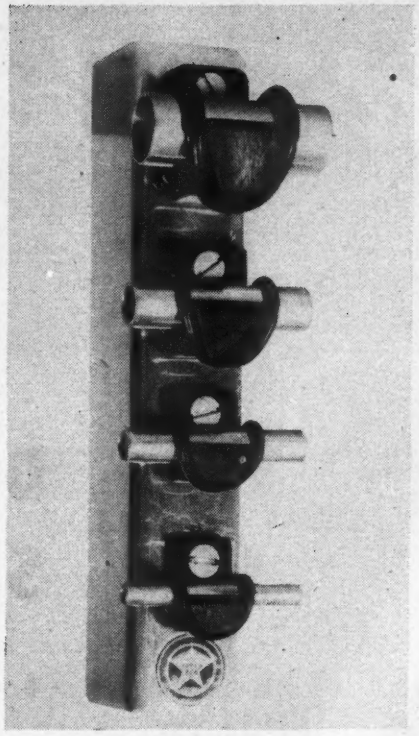


FIG. 2—Metal clamps can be made in a variety of sizes, as is done in The Glenn L. Martin Company plant.

DEAD-END BRACKETS FOR OPEN WIRING CIRCUITS

WIRING

When the Dodge-Chicago Plant, Division of the Chrysler Corporation was constructed to turn out B-29 engines, copper and steel were among the most critical material items on the long list of scarce metals. Consequently, the engineers planning the electrical system used every available substitute and method of reducing the quantities of such metals required. As a result one sees a vast amount of open wiring installed throughout the plant—this method eliminating the use of steel conduit and reducing the total amount of copper used through the increased allowable carrying capacity of conductors when suspended in open air.

One of the most pertinent problems encountered was at the point where open wiring circuits to electric furnaces were to be terminated. In a number of instances this required a dead-end bracket of some type, not only as a juncture point to the furnace electrode leads, but also to take care of the strain necessary to keep the conductors taut.

Three distinct types of brackets were designed and installed under the floor of the nitriding and carborizing departments to dead-end open wiring circuits feeding the various furnaces. The type illustrated in Fig. 2 was used where it was necessary to keep some of the conductors above the bottom of the concrete beams to provide access to a flanged pipe coupling on the bottom of the adjacent furnace. Here a welded, double angle-iron bracket—triangular in shape—was de-

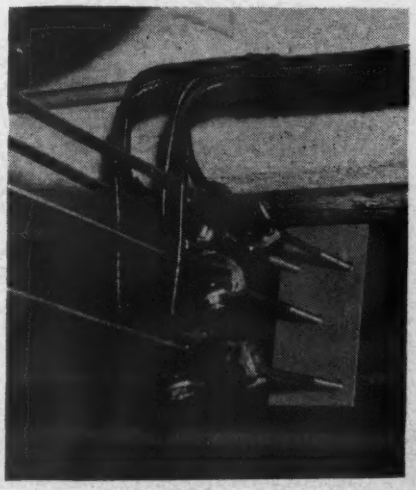


FIG. 1—Simple channel iron brackets were used frequently to dead-end open wiring feeders. Deep concrete beam and broad face of channel provided excellent mounting facilities. This method was employed where space limitations were not a factor.



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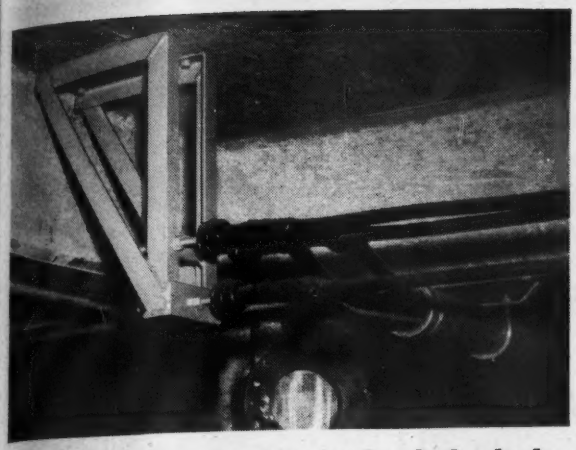


FIG. 2—Heavy duty triangular bracket dead-ends the heavy conductors feeding this electric furnace. Feeder had to be kept at proper height to clear large flanged coupling below and permit easy access to furnace conduit at right.

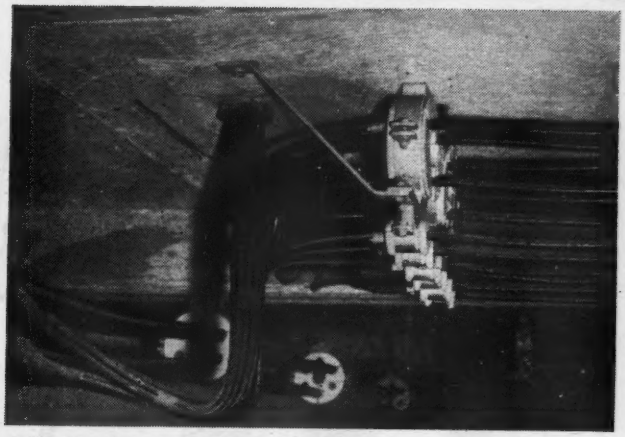


FIG. 3—In congested areas split porcelain insulator assemblies were bracket mounted to provide for change of direction of numerous conductors. Marlin wrapping on individual conductors directly behind porcelain unit took up some of the strain.

signed and bolted to the concrete ceiling. To the vertical legs of the bracket were mounted bolt-type dead-end strain insulators. Tension on the circuit conductors was applied and maintained by tightening the front and rear nuts on the insulator bolt where it goes through the bracket.

Sections of ordinary 6 inch by 2 inch channel iron were frequently used as dead-end brackets where the conductors could be run just below the bottom of the floor beams (Fig 1). The broad face of the channel provided ample area to receive the bolts of the clevice-type spool insulators at normal conductor spacing as well as offering ample contact area for bolting to the back of the concrete beams. The circuit conductors were looped around the spool insulator, clamped, then extended along the front side of the beam to the conduit raceway entering the furnace housing. Tension was applied to the conductors merely by taking up the nuts on the clevice bolts.

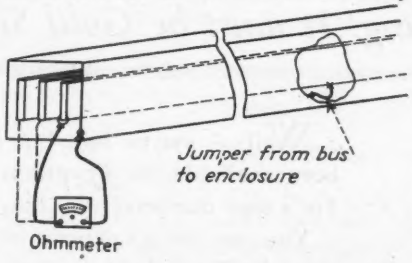
A third type of bracket was installed directly under the furnace controls which were located on the floor above. The conductors leaving the control enclosures passed through conduit sleeves in the floor, made two right angle bends, and continued through the split porcelain insulator assemblies mounted on this bracket. The top of the three-conductor insulator rings (triangular spacing) were bolted direct to the concrete ceiling; the bottoms were bolted to the ¼ inch by 1½ inch flat-iron cross piece of the bracket (Fig. 3). To the underside of the cross piece were mounted single-conductor insulators. A vertical supporting arm and two angle braces completed the assembly.

Because of the number of conductors and the limited space, dead-end strain insulators were not used. Instead the split porcelain units were permitted to take up a slight strain—each conductor just behind the insulator to prevent it from slipping when the conductors were stretched through the other units and the slack taken up gradually throughout the length of the run.

LOCATING LOOSE BUS CONNECTIONS

MAINTENANCE

The lap joints of copper buses in bus duct are normally bolted together where sections join each other. Sometimes, through vibration or even electrical stresses due to a fault or heavy overload, such bolted connections will become loose. Continuous arcing at these points, under load, may eventually burn through the bolted connection and cause considerable grief, particularly if a production shutdown results.



Test circuit used to check enclosed buses for loose or open connections. High reading indicated intact bus; low or no reading, a loose or open joint.

For this reason, Carl Lau, chief electrician of the Nordberg Manufacturing Company, Milwaukee, Wis.,—one of the largest producers of diesel engine equipment and other heavy machinery —makes a point of checking his bus duct systems whenever they can be "killed" for a few hours. He keeps a weather-eye open for loose connections.

To locate loose connections in the buses, Lau's maintenance electricians make a simple ohmmeter test. Without such a meter test, removable covers at the junctions would have to be opened and the bolts checked.

One side of the ohmmeter is connected by a spring clip lead to one of the buses; the other side to the duct enclosure (ground). The test circuit is completed by connecting the same busbar at a distant point—say four or five sections away—to the duct enclosure (a lead with two spring clips is used). The ohmmeter reading is observed and noted. The same procedure is repeated for the second and third buses—the reading being noted each time.

The bus giving the highest reading is intact; that giving a lower reading probably has a loose connection somewhere between the portion under test; and the bus which gives no reading at all may have burned-off bolts—causing the open circuit. To locate the actual position of the loose or open connection, the length of bus under test is gradually decreased until the faulty section is discovered.



Kept busy with electrical reconversion work in Flint's automotive and other industrial plants is L. Schroth, president of United Electric Company, prominent Flint, Michigan electrical contracting firm.



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You can always depend on it to stay "tacky" and stick to the job. That's because there is plenty of live rubber in the friction compound. Each batch of compound is laboratory checked, and every fibre of the strength-tested base cloth is thoroughly impregnated.

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FRICTION and RUBBER TAPES

DATA SHEET

The number at the right is a classification for convenience in filing and for a future data sheet index

XM-1

Moving Motor-Generator Unit

BUILDING CONSTRUCTION:

The type of building construction does not affect the labor units involved in moving the equipment to its installation location.

NATURE OF JOB:

An office building where numerous business machines and calculators were used. Additional machines were installed increasing the necessary electrical load. It is generally known that, because of more efficient operation, business machines are equipped with direct current motors and controls. The building in question had only an alternating current service and the machines were served by a 30 kw., a.c.-d.c. motor-generator set. This unit was inadequate for the added load of the new machines and was replaced with a 40 kw. unit.

JOB CONDITIONS:

The generator set was delivered to a loading dock. It had to be accepted at that point, moved inside the building on pipe rollers, rolled to a freight elevator, moved from the elevator to the point of installation. The total distance the unit was rolled was approximately 300 ft. The building had ideal facilities. All freight passageways were clear; the elevator was adequate; and there was no trouble getting the generator unit off the loading dock. Pipe rollers used were 2½-in. size.

LABOR ANALYSIS

The data given above does not include any time for connections, fastenings, etc., as it was desired to isolate the man-hours for moving a piece of heavy equipment to its installation position from a distant point of delivery within the building. It took three men to handle the job.

This is the type of equipment for which a foreman would normally send more men than actually needed. There is a general tendency to over-man when handling equipment. At the time the unit arrived there were only three men on the job. If there had been five men on the job, they would probably all have gone to assist in unloading and moving the unit. In that case the labor would have been 20 man-hours instead of the 12 man-hours actually recorded to do the job. *A reasonable unit to apply to jobs of a similar nature would be 16 man-hours.*

LABOR DATA

Work Involved	Total Man-Hours
Receive a 40 kw. motor-generator set (60 hp., 440-v., a-c motor; 40 kw., 110-v. d-c generator); roll to elevator, transport, move from elevator, roll to installation location, set unit down on prepared cork base. Total distance approximately 300 ft. Time given does not include bolting to floor	12.0

LABOR CLASSIFICATION:

Three "B" men were used on the job.

The types available labor are rated A-B-C-D-E, with the units based upon average use of B labor. In general, an A man will run the job assisted by B and C labor, which will average class B. In abnormal times the general labor classification will fall to D and E for new labor being employed to fortify the regular personnel. It must be noted that the classification applies only to rate of time and not to knowledge or mechanical ability. A splendid mechanic may be rated C from a rate of time classification.

Labor Classification	Changes in Standard Units
A	deduct 10%
B	no change
C	add 10%
D	add 20%
E	add 30%

The labor classification shown in the estimating data above shows the labor classification rating of the mechanics who performed the particular job so that adjustment can be made on the type of labor available.

Data from L. W. Witz, Continental Electrical Construction Co., Chicago, Illinois

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ELECTRO Fluorescent Basic Unit!



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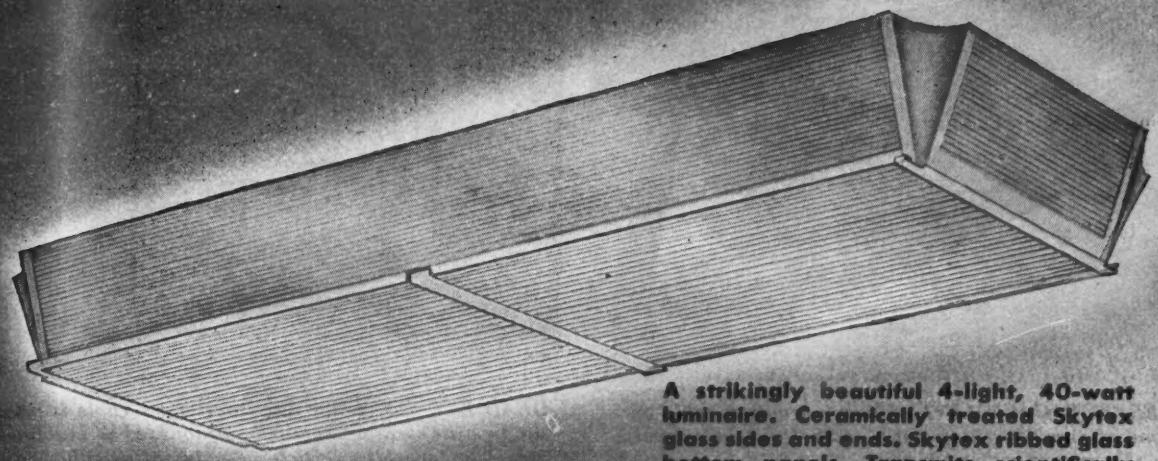
Obviously, you've got a better chance of landing large orders if you can *complete* delivery immediately. THIS NO LONGER NECESSITATES EXPENSIVE BIG INVENTORIES ON *EACH* TYPE OF COMMERCIAL LUMINAIRE. You need stock only one major item—the ELECTRO BASIC UNIT, which you can convert instantly into any type commercial luminaire, with the aid of accessories from packaged sets. Thus, with a much *smaller* total stock, you can fill *larger* orders for any given model.

Moreover, when you sell Electro luminaires you are sure of a satisfied customer. For no other line of fluorescent lighting offers all the features and all the quality you get in Electro ... engineered for highest levels of lighting, yet with amazingly low surface brightness ... Starters and lamps instantly removable from the top, and wiring more readily accessible than on any comparable fixture ... Patented suspension bracket that enables *one man* to install any fixture in less time than is ordinarily required by two men... Designs of breathtaking beauty ... A selection of models affording exact desired concentration of light.

Send for literature showing the spectacular engineering improvements featured in these fluorescents. Sold only by verified electrical wholesale distributors.

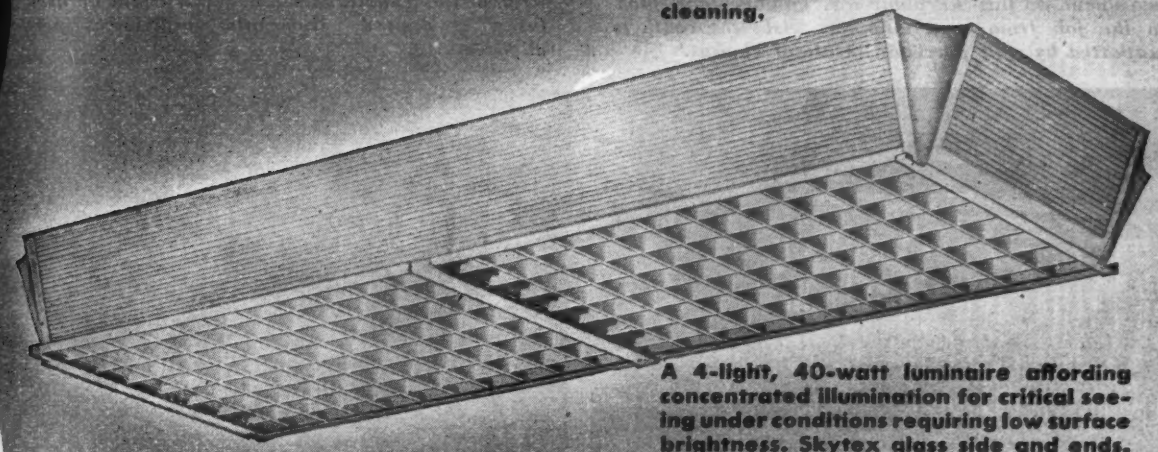
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AID EVER OFFERED!..



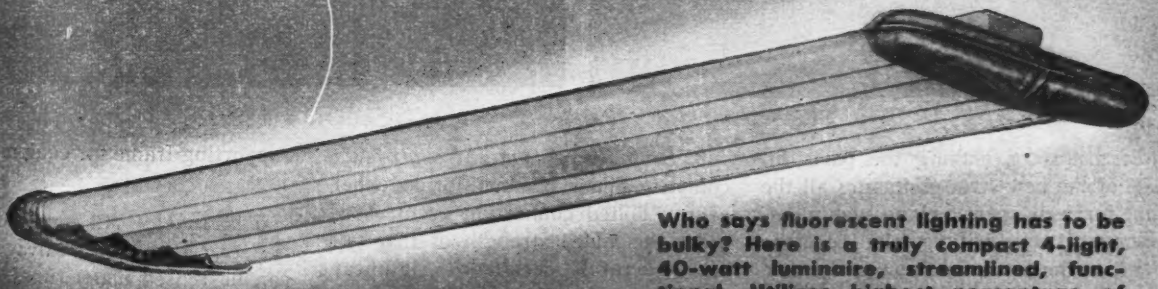
*ELECTRO U. R. C. LUMINAIRE, NO. 1041

A strikingly beautiful 4-light, 40-watt luminaire. Ceramically treated Skytex glass sides and ends. Skytex ribbed glass bottom panels. Transmits scientifically diffused maximum light, clear and glareless as the daylight in a room with ideal north exposure. Glass easily removed for cleaning.



*ELECTRO LOUVRE MODEL, NO. 1043

A 4-light, 40-watt luminaire affording concentrated illumination for critical seeing under conditions requiring low surface brightness. Skytex glass side and ends. Steel concentrator panel in bottom contains louvres of size and number determined by extensive laboratory experiment to assure highest efficiency. An unusually handsome luminaire.

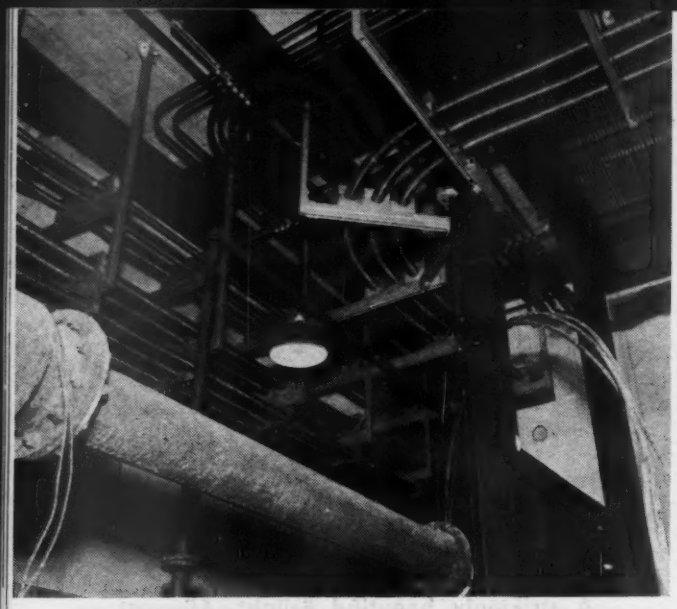


*ELECTRO'S NO. 1044

Who says fluorescent lighting has to be bulky? Here is a truly compact 4-light, 40-watt luminaire, streamlined, functional. Utilizes highest percentage of lumen output of the bare lamps. No dark spots on ceiling. Exquisitely designed bakelite ends in rich walnut grain.

ALSO AVAILABLE: No. 1022, two-lite, 40-watt luminaire, same style as 1044.

*FOR FLUSH OR PENDANT MOUNTING, IN CONTINUOUS LINE OR INDIVIDUALLY

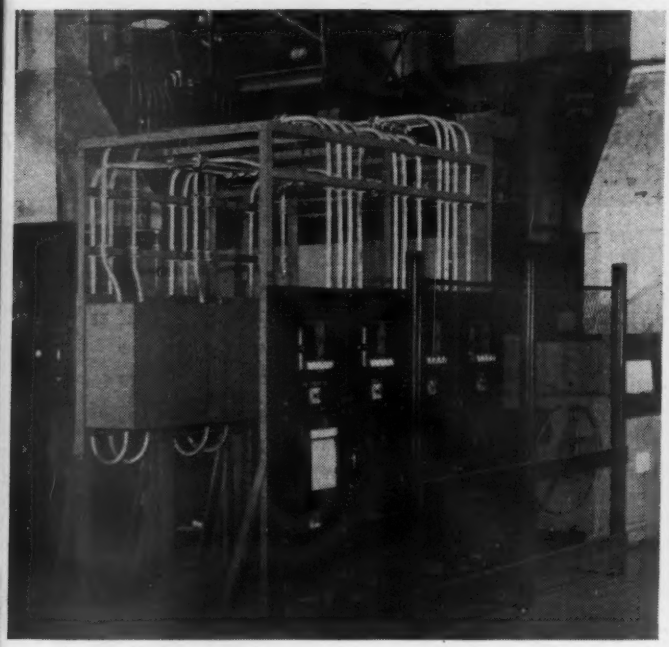


***PERFECT ALIGNMENT** of heavy armored cable and conduit runs is accomplished with Unistrut supports in this municipal power plant.*



***DEAD END** for trolley duct messenger cable is provided by a single strut section beam-clamp mounted to building channels. Strut slot provides verticle adjustment of cable.*

***FREE STANDING RACK** for electric furnace control equipment in this warplant was quickly fabricated on the job from strut members. Asbestos cable is supported by split porcelain insulator clamps.*



***BUS INSULATORS** are supported from short sections of Unistrut in this generator room. Strut could be used flush as an insert if desired. Horizontal adjustment permits perfect alignment.*



shift means of making the parts fit. Use of the new strut eliminates all the time formerly spent making such measurements and drilling the requisite holes. The open continuous slot and special nut of the strut permits bolted connections to be made *where equipment mounting holes occur.*

2. *Permits Perfect Alignment* — Equipment and controls mounted to the new strut framework can be aligned after connection to conduits thus precluding the need for offsets, nipples, etc. formerly used when errors were made in spotting the punched or drilled holes.

3. *Provides Added Strength*—The complete square channel, formed wherever a bolted connection occurs, provides the added strength of that type of structural design—a significant feature where suspension of heavy equipment are involved.

4. *Adds Flexibility*—The square formed strut provides flat working surfaces permitting various members to be revolved to any 90 degree position. The continuous open slot permits quick and easy mounting adjustment.

5. *Installs Easily*—The unit can be surface mounted, utilized as an insert in concrete ceilings or floors, or used as supporting frame for equipment mounting.

6. *Reusable*—All component parts of the strut have a high salvage value and can be reused many times. Time for dismantling, like that for fabrication, is held to a minimum.

Many contractors have applied this structural method in their wartime activities; many have not. Time will be an important factor in the completion of the vast amount of postwar construction that lies ahead. Any development that expedites installation work merits the careful consideration of engineering staffs.

Ready WITH A WIDER CHOICE

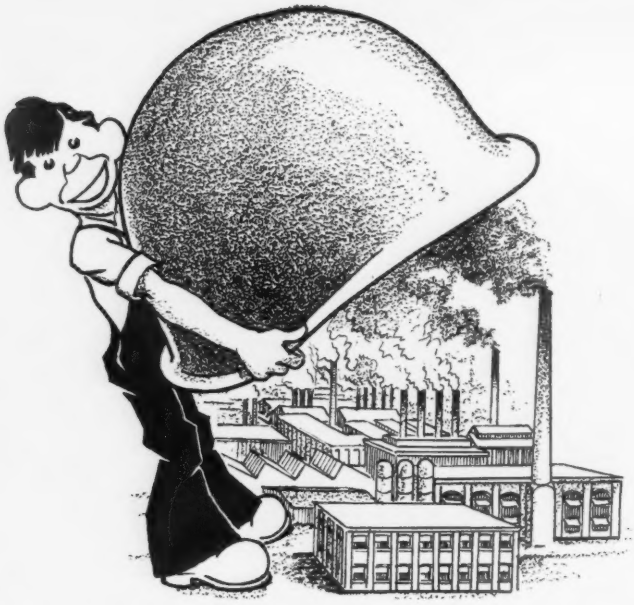
to broaden the service of electrical contractors



Your Graybar Man is ready with electric equipment, supplies, and product information to help you do a bigger job than ever for your customers. The electrical needs of building construction and modernization are growing broader and more complex. Graybar has a wider range of products — old favorites and new — *locally available* to meet them.

via GraybaR

The following pages show key products of some of our leading suppliers. At every Graybar warehouse, experienced men who know and support the well-qualified contractor are on deck to help you select and supply the best in wiring, lighting, signaling and power apparatus — including the latest electronic devices — for all your customers' needs.



WITH THE LID OFF

T&B

HOW TO ORDER

Order these economical T&B Pressure (Solderless) Connectors and all other T&B electrical fittings from the stock of your nearby Wholesaler.

T&B Distributors are located in all important centers in the United States and Canada. They specialize in T&B products all of which, under the T&B Plan, are distributed exclusively through their experienced service organizations.

If you have any difficult technical wiring problems, our Engineering and Development Departments are equipped to help you with special connector designs. Do not hesitate to write us.

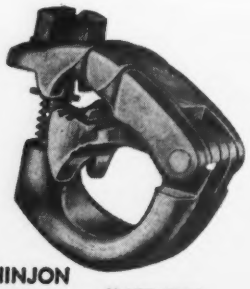
Full lines of T&B Pressure (solderless) Connectors are quickly available for your profitable use in reconversions and new construction.

We call your particular attention to the compact T&B Lock-Tite Line. Each fitting takes a wide range of cable sizes. One piece design, no loose parts. Just a handful of assorted sizes does the work of hundreds of conventional type lugs and taps. Lock-Tite Connectors install fast with screw driver or wrench. Full salvage value. Designed by T&B Engineers, and made up to highest standards of electrical performance. Approved by Underwriters Laboratories.

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INCORPORATED
manufacturers of electrical fittings since 1898
ELIZABETH, N. J. NEW JERSEY
In Canada: Thomas & Betts Ltd. Montreal



LOCK-TITE TEE-PARALLEL TAP (PATENTED)



HINJON JUNIOR (PATENTED)

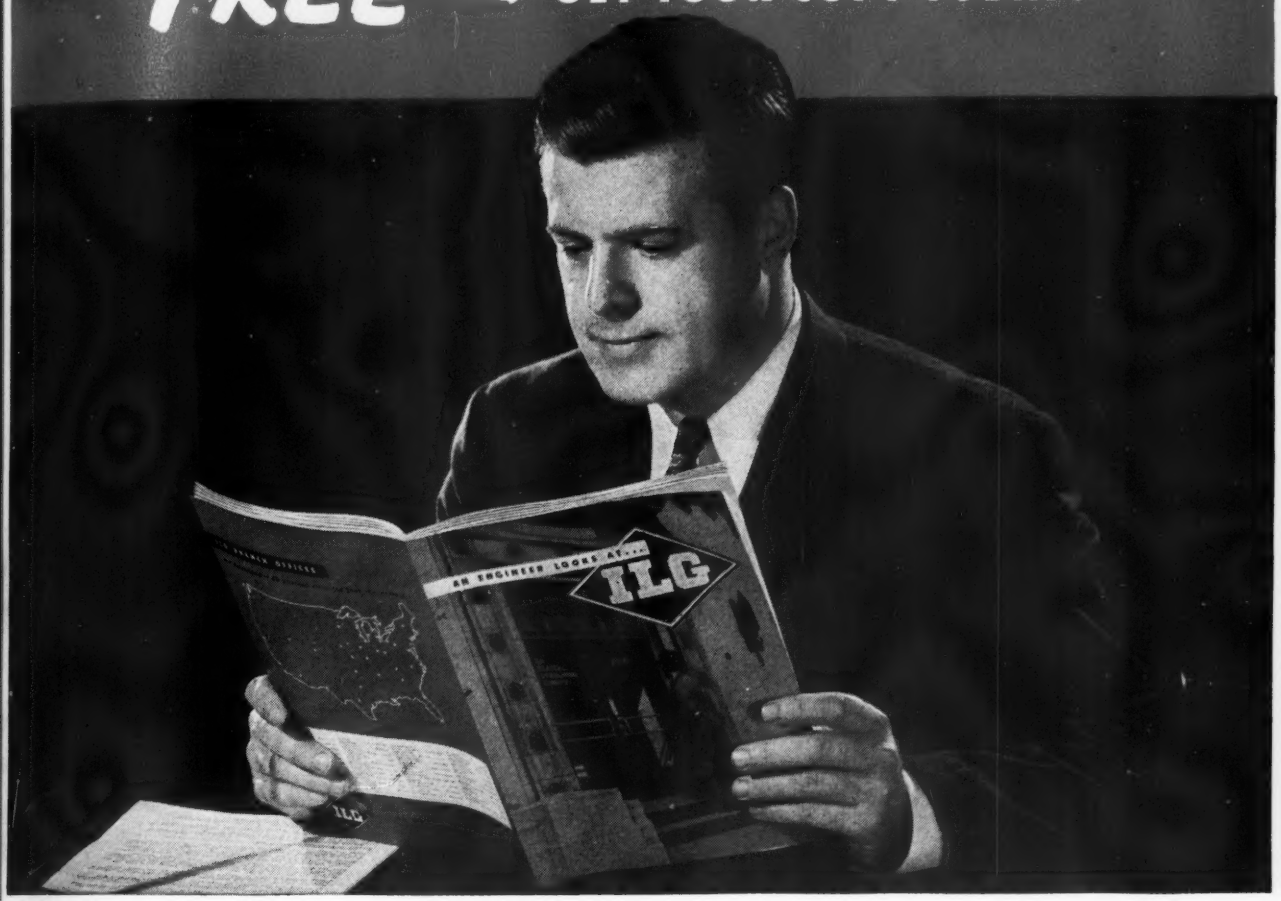


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LOCK-TITE LUG

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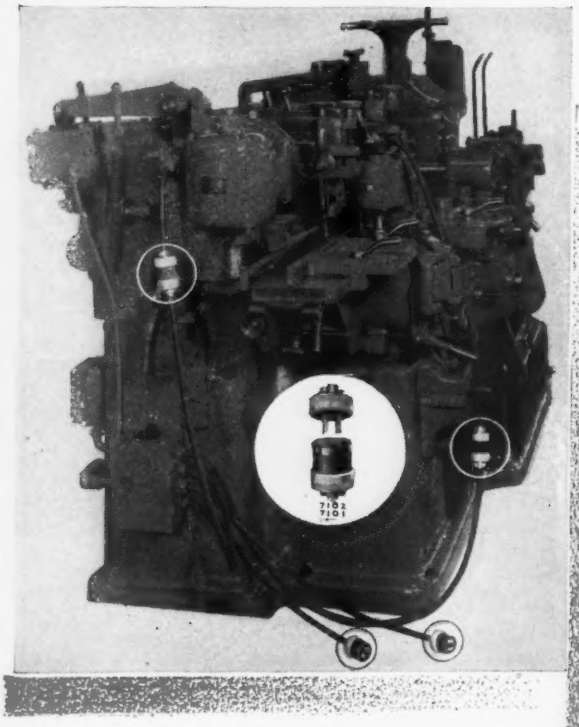
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. . . TO BROADEN THE CONTRACTOR'S SERVICE

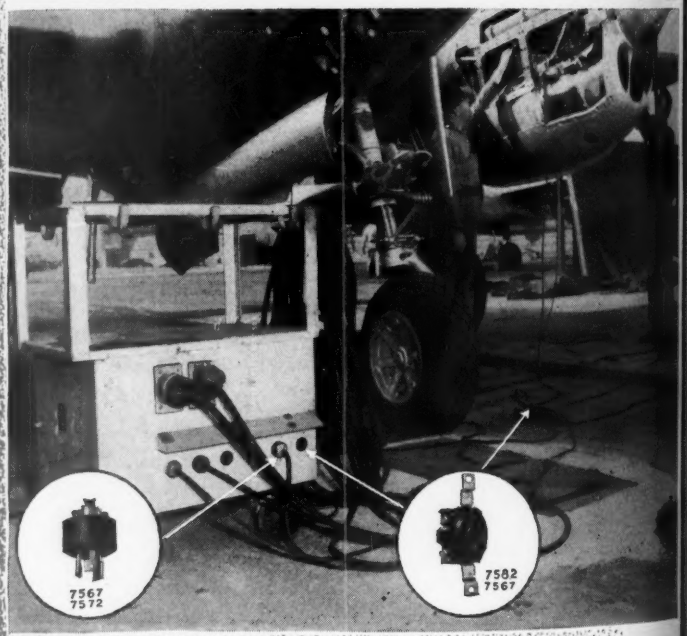


Locked POWER



Contractors, manufacturers and designers of electrically operated machines and tools look to Hubbell for the finest in wiring devices.

Proven by "round the clock" service in yesterday's war plants, and on the far-flung battlefronts, time proven and battle tested *Twist-Lock* Devices will provide an uninterrupted power supply for the peace-time industrial world.



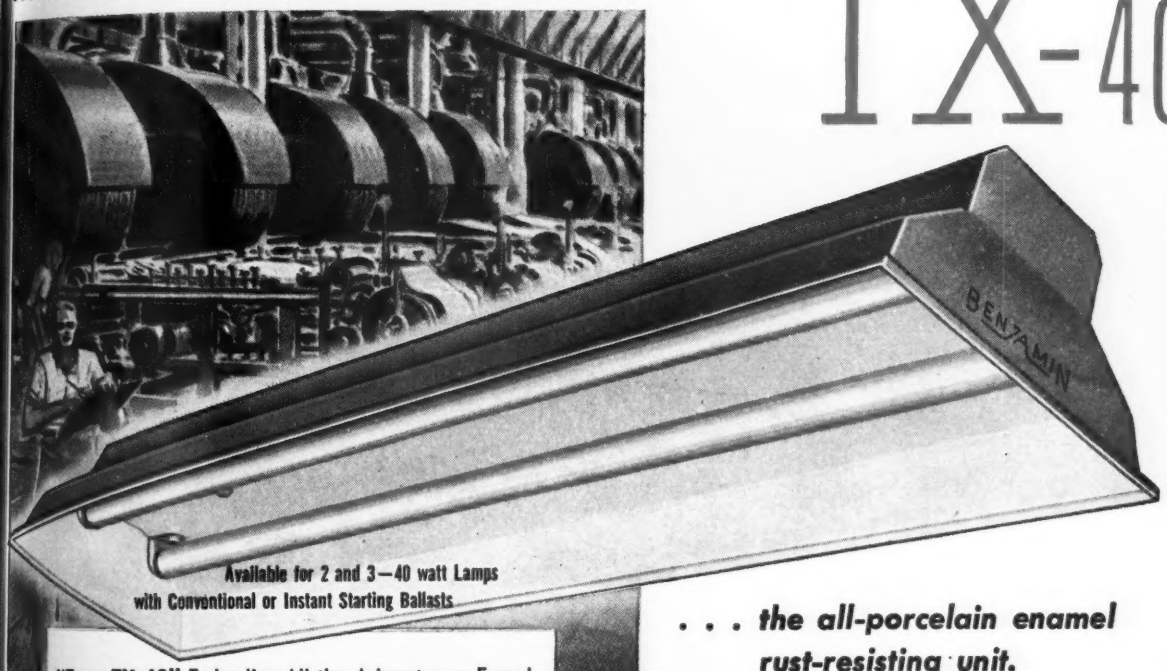
Twist-Lock **Connecting devices meet all requirements for continuous uninterrupted service in the operation of portable electrical apparatus and machinery by providing a locked electrical connection. Positive, mechanical engagement of the cap contacts within the receptacle make accidental pull-out impossible.**

HUBBELL *Twist-Lock* CONNECTORS

HARVEY HUBBELL INC. BRIDGEPORT, CONN.

Via Graybar —READY WITH A WIDER CHOI

Humid, Damp and Dusty Locations call for this new one-piece Fluorescent Lighting Unit .... the new "TX-40"



Available for 2 and 3—40 watt Lamps with Conventional or Instant Starting Ballasts

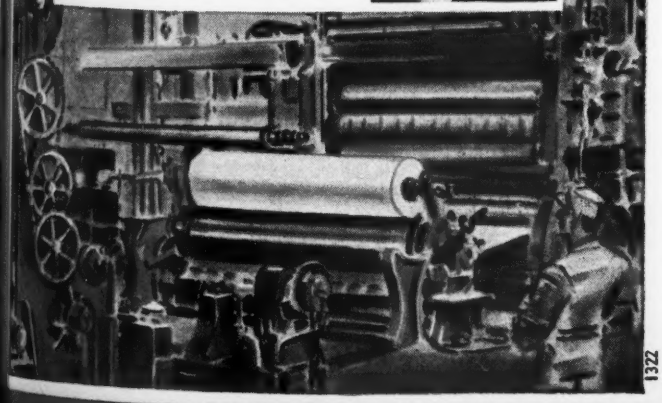
"Type TX-40" Embodies All the Advantages Found in All BENJAMIN FLUORESCENTS

- √ Benjamin Life-Time Porcelain Enamel
- √ Built-Like-A-Battleship Construction
- √ Easier Installation and Maintenance
- √ Certified Conformance to highest illumination, mechanical and electrical standards and specifications.

PLUS—

- √ SPECIAL RUST RESISTING HOUSING. Entire exterior of unit is single coated with gray porcelain enamel over a ground coat for extremely high resistance to rust. Inside section porcelain enameled with two white coats over a ground coat.
- √ ONE PIECE REFLECTOR HOUSING for durability and long life.
- √ REMOVABLE PORCELAIN ENAMEL STEEL PLATE on which control equipment is mounted forms the reflector top; removable by releasing two screws for easy wiring or inspection of ballasts.





1322

. . . the all-porcelain enamel rust-resisting unit.

Rust and other problems due to humidity and dust meet their master in the new Benjamin "Type TX-40." Now, even the most humid locations can be economically provided with fluorescent illumination through lighting units especially designed and constructed for such purposes.

"Type TX-40" Fluorescent Lighting units have wide applications in textile mills, paper mills, food plants, laundries and other process industries. In these locations the one piece all porcelain enamel construction of the "Type TX-40" unit provides durability and long life operation not possible with ordinary units. For complete data on these units and other Benjamin Fluorescent equipment . . . ***write Benjamin Electric Mfg. Co., Dept. H, Des Plaines, Ill.***

BENJAMIN THADE MARK

PORCELAIN ENAMEL *Fluorescent*

LIGHTING EQUIPMENT

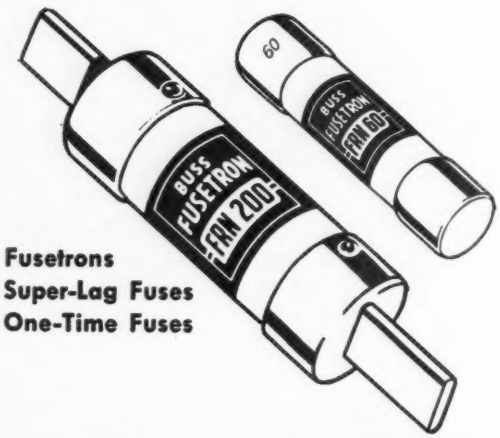
Distributed Exclusively Through Electrical Wholesalers

. . TO BROADEN THE CONTRACTOR'S SERVICE

These TWO FREE HANDBOOKS

Will Help You Get the Most Service from Your Fuses

"FUSEOLOGY" and "PROTECTION HANDBOOK" —offered by the makers of BUSS Fuses



BUSS Fusetrons
BUSS Super-Lag Fuses
BUSS One-Time Fuses



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BUSS Plug Fusetrons
BUSS Plug Fuses

Do you know –

What to do when fuses blow?

Where to look for trouble that caused fuses to blow?

What to do after you have found the trouble?

How to select the right type fuses for various circuits?

How to determine the proper size fuse or fusetron?

How to save material and cut costs on motor installations?

(Answers to these and many other questions are found in "FUSEOLOGY")

Do you know –

How to determine size wire to be used—and volt loss?

How to select the proper protective device for electric circuits, motors, appliances, and apparatus?

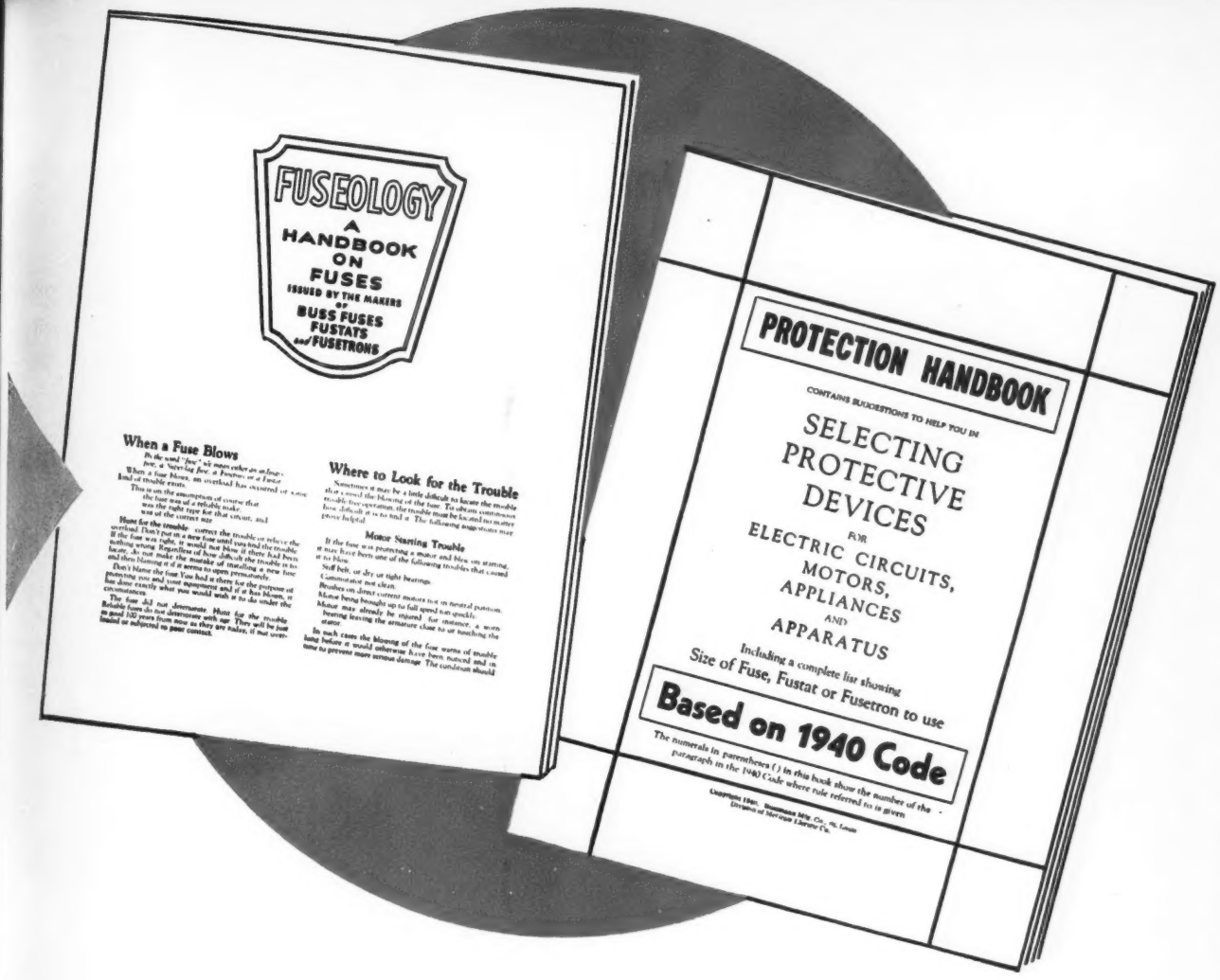
Code rules on motor protection?

Size of switch or fuseholders required?

(These are typical questions answered in "PROTECTION HANDBOOK")

BUSS FUSES

Via Graybar —READY WITH A WIDER CHOI



THESE helpful handbooks are furnishing many maintenance men, electricians, and contractors with useful, practical information. Everything in them is practical, clear, simple, and understandable. Both of these handbooks are well illustrated with charts, diagrams, and drawings. Anyone connected with fuse maintenance or installation can get these practical aids free.

If there are other men in your organization who you think would find either or both of these booklets helpful, send their names also.

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Division McGraw Electric Company
University at Jefferson, St. Louis, Mo.

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Please send me a copy of: ☐ Fuseology ☐ Protection Handbook. Check one desired.

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SMALL TOOLS DO BIG JOBS

on Construction and Maintenance



Power-packed, yet light and easy to handle, Thor Portable Electric Tools save hours and dollars on construction, repair and renovation work. Check the many tasks they'll do for you *faster*. See or call your nearby Thor dealer or Thor branch office today.

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MAKE HOLES FASTER with Thor electric drills. Capacities from ¼" to 1 ¼". Speeds for any material.

DEMOLITION IS QUICK and sure with the Thor-Nado portable electric hammer.



SAWING IS SIMPLE... and safe with a Thor Electric Saw. 5 models with capacities from 6 to 12-in. blades.

Thor PORTABLE ELECTRIC TOOLS FOR EVERY CONSTRUCTION JOB

- *Drills* • *Saws* • *Hammers* • *Grinders*
- *Sanders* • *Polishers* • *Screw Drivers*
- *Nut Setters* • *Tappers* • *Nibblers*

Thor PORTABLE POWER TOOLS

PNEUMATIC TOOLS • UNIVERSAL AND HIGH FREQUENCY ELECTRIC TOOLS • MINING AND CONTRACTORS TOOLS

Via Graybar —READY WITH A WIDER CHOI

Again . . . THE FREEDOM *to* BETTER SERVE THE CONTRACTOR *with* . . .



QUALITY, STANDARD LIGHTING EQUIPMENT BY

CURTIS

The standard lighting units on which the Curtis reputation rests are again flowing into trade channels, and contractors can quote freely on many time-tested and proven Curtis Luminaires.

Many distributors already have substantial stocks of the more popular Curtis fixtures and factory deliveries, while not up to pre-war standards, are getting better all the time.

Sell SkyLux, "X-Ray" Show Window Units, Curtis Recessing Equipment and other Curtis Products with assurance that you are making a satisfied customer.

Dig out your Curtis Catalog 42 or write for specification sheets on the items illustrated.

1. CURTIS SKYLUX
2. FLUORESCENT CURTISTRIP
3. "WINNER" LUMINAIRE
4. SHOW WINDOW REFLECTOR
5. SPECIAL LUMINAIRE
6. CURTISTRIP WIRING CHANNEL
7. RECESSING UNIT
8. CURTIS STARLUX

CURTIS *Lighting*, INC.

6135 WEST 65TH STREET, CHICAGO 38, ILLINOIS

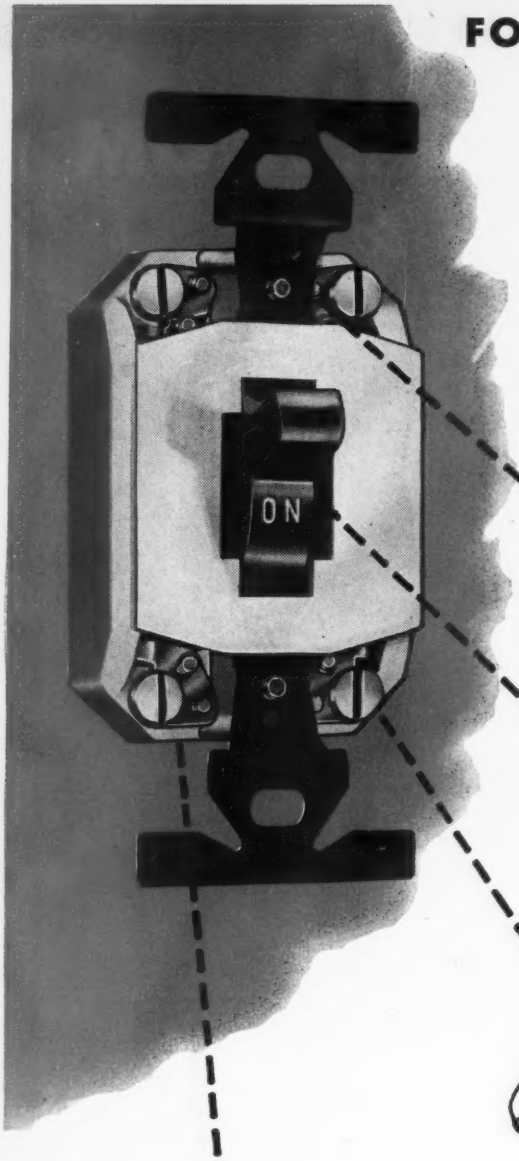
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FOR DEPENDABLE GENERAL SERVICE

USE BRYANT 3951 LINE OF SWITCHES

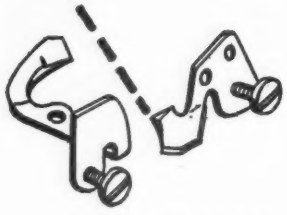
For general service you want switches you can trust. The Bryant 3951 line of flush tumbler switches has been thoroughly proved under all conditions in millions of installations. They are "T" rated at 10 amps, 125 volts—5 amps, 250 volts.

The mechanism is housed in a shallow porcelain cup desired by so many experienced contractors, and is available in single-pole, double-pole, three-way and four-way types. Non-breakable handles are supplied in brown or ivory, as well as special lock or momentary contact types to meet the demands of every installation.





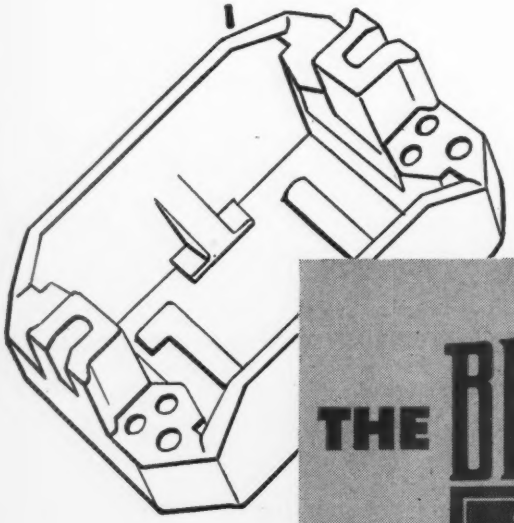
Heavy steel yoke, protected against corrosion, has integral plaster ears for flush alignment on irregular surfaces. Ears scored for easy break-off if not desired.



Contacts with adequate terminal screws arranged for easy top-wiring . . . particularly helpful in replacements.



Trouble-free, long life at rated capacity ("T" rated) is assured by quick-acting, arc-resisting mechanism.



White porcelain shallow cup, enclosing the mechanism compactly, permits installation in shallow-type boxes. Reinforced at stress points to assure lasting durability.

Specify Bryant Devices from your Electrical Wholesaler

THE BRYANT ELECTRIC COMPANY

SUPERIOR WIRING DEVICES

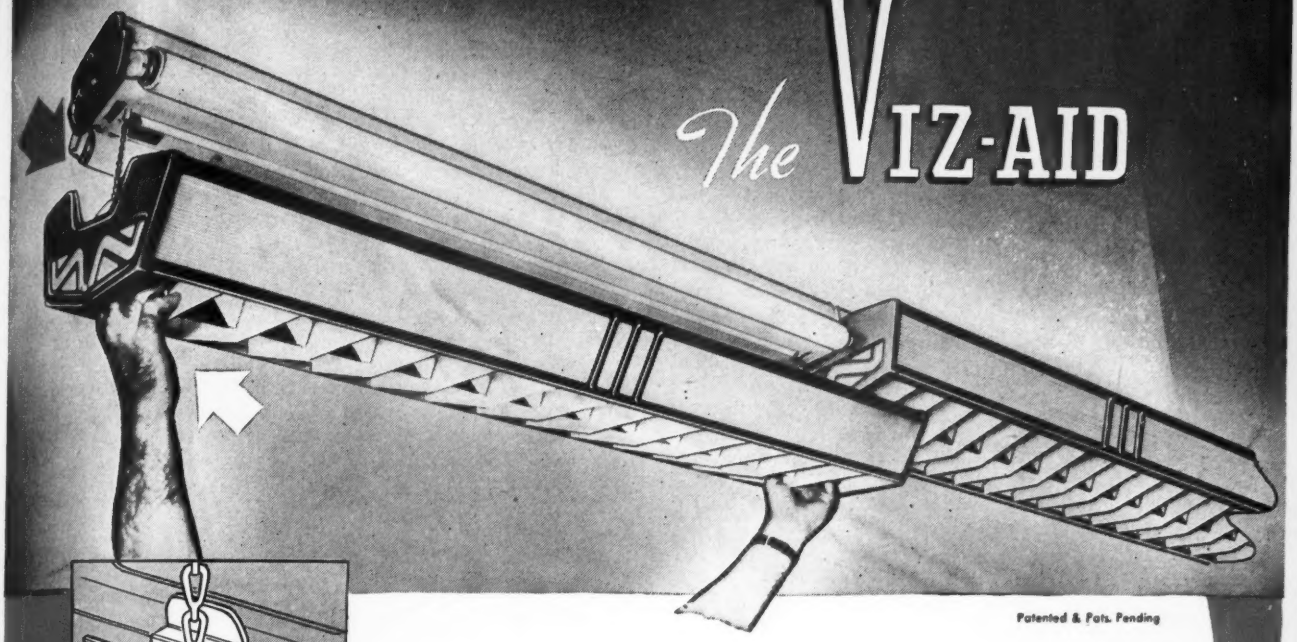
BRIDGEPORT 2, CONNECTICUT

NEW YORK SAN FRANCISCO CHICAGO LOS ANGELES

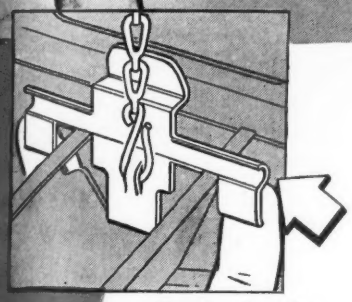
Via Graybar —READY WITH A WIDER CHOI

IT'S EASY TO SEE WHEN IT'S "DAY-BRITE"

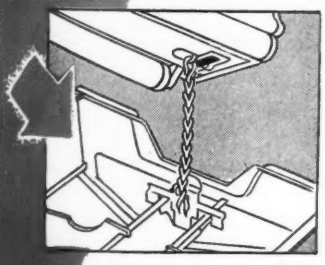
The VIZ-AID



Patented & Pats. Pending



Showing location and accessibility of spring-tension clips.



Chains hold lowered enclosure in position.

Look...it's easy to see that it's easy to service!

It takes only a matter of seconds to reach into the ends of the VIZ-AID individual-unit enclosure, release 2 spring-tension clips and drop the enclosure... It is retained in its lowered position by 2 service chains, which unhook from the chassis if you wish to remove the enclosure entirely. To return the enclosure to its original position merely snap it back into place ... An exclusive Day-Brite feature that saves lots of time... *Complete operation, on and off, takes only a few seconds.*

MORE LIGHT... ***in the useful zone of illumination***

Day-Brite's *exclusive* specular V-shaped louvers provide added light in the useful area of illumination. Louvers are tied into frames, assuring permanent, rigid alignment... No horizontal surfaces to catch bugs or dirt... More pleasing side illumination secured with ribbed glass panels ... For continuous run or unit installations—surface or suspension mounting—two 40-watt lamps... Write for VIZ-AID Bulletin 10-B.

Consult your nearest Day-Brite Representative

Day Brite
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LIGHTING FIXTURES

DAY-BRITE LIGHTING

Incorporated

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THE SIGN OF *Quality* LOOK FOR THIS LABEL

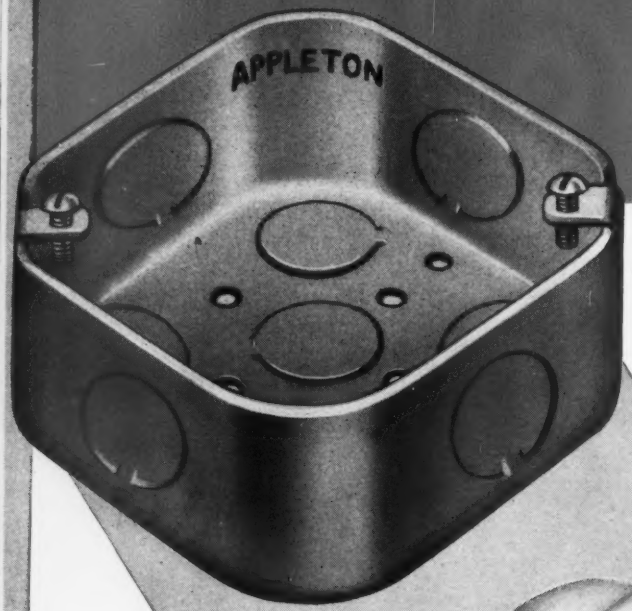
TMs Reg. U. S. and Foreign Countries

107

• *Nationally distributed through leading electrical supply houses*

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STANDARD for BETTER WIRING



Square and Octagonal Outlet Boxes in various sizes, with a wide selection of covers. Also Switch Boxes of every type and size.

COMPLETE APPLETON LINE

Answers *Every* Wiring Requirement

● Outstanding in completeness—the Appleton line of over 15,000 items offers a size and type of electrical fitting for every preference and specification! . . . That means time-saving, easy installations!

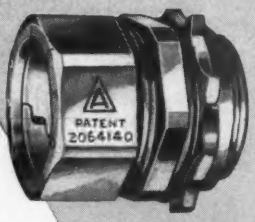
All fittings and fixtures are made in Appleton's own foundries and fabrication plants, designed to the most exacting standards of high quality and rugged dependability — they'll last the life of the building! That means money-saving, efficient operation!

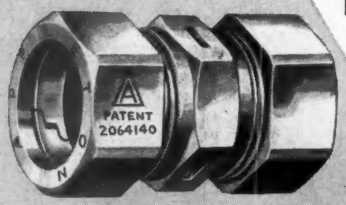


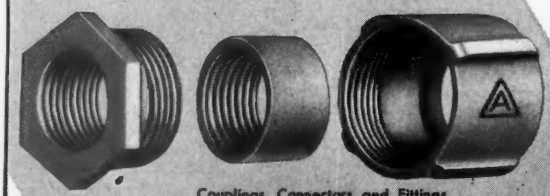
Fittings and Connectors, threaded or no-thread, in various types and sizes, for every entrance requirement, including REA cable accessories.

Send for the big Appleton Catalog, with complete descriptions of 15,000 items.









Couplings, Connectors and Fittings of every size and type for electrical metalic tubing, rigid conduit, flexible conduit, or armored cable.

Sold Through Wholesalers

APPLETON ELECTRIC COMPANY

1704 Wellington Ave. Chicago 13, Illinois

Branch Offices: NEW YORK, 76 Ninth Ave. • DETROIT, 7310 Woodward Ave. • CLEVELAND, 1836 Euclid Ave. • SAN FRANCISCO, 655 Minna Street • ST. LOUIS, 420 Frisco Bldg. • LOS ANGELES, 100 North Santa Fe Ave. • ATLANTA, 203 Luckie St., N. W. • BIRMINGHAM, 6 N. Twenty-first Street • MINNEAPOLIS, 305 Fifth St., S. • PITTSBURGH, 418 Bessemer Bldg. • BALTIMORE, 100 E. Pleasant St. • BOSTON, 10 High St. • DENVER, 1536 Sixteenth St. • PHILADELHIA, 1217 Race St.

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APPLETON ELECTRIC PRODUCTS — REG. U.S. PAT. OFF.

APPLETON

CONDUIT FITTINGS • OUTLET AND SWITCH BOXES • EXPLOSION-PROOF FITTINGS • RELITES

Via Graybar —READY WITH A WIDER CHOICE



Wanted: Pleasing, high-level lighting for the design section of a large plastic manufacturer . . . lighting as up to date as the plastic forms to come from its drafting boards.

Problem: A medium-brown acoustical ceiling which meant less reflectivity; necessitated lighting that would provide plenty of light down on work. Also desired was overall light throughout the room for greater eye comfort.

Solution: Continuous rows of Wakefield Generals (No. G-260) using two G-E 100-watt lamps in each unit. The translucent plastic sides and open top of the units mean light on walls and ceiling for reduced contrast and well-diffused distribution of light. Deep shielding provides protection from excessive brightness. Units mounted in rows 8 feet, 6 inches apart. Ceiling height, 11 feet. Bottom of units, 9 feet, 5 inches from floor.

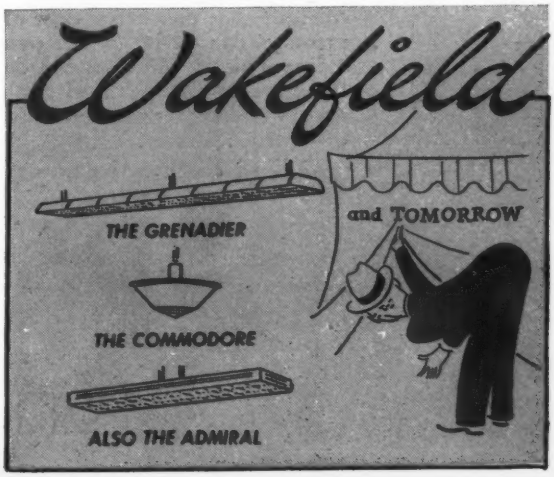
The result: 37 footcandles on the board and a room with real eye comfort in which to work.

The lighting problem of your customer may be different. But you can be sure of this: Wakefield and your local Graybar lighting man will be glad to work with you on engineered lighting for office or drafting room. The F. W. Wakefield Brass Co., Vermilion, Ohio.

Are your customers throwing away DOLLARS?

Proper lighting maintenance—cleaning fixtures and walls and relamping—can double or triple their light. Urge them to get the lighting value they pay for. It's important to you!

Ask Your GraybaR House About



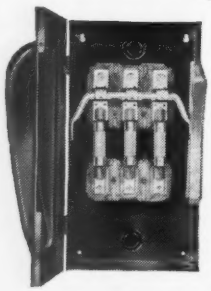
. . TO BROADEN THE CONTRACTOR'S SERVICE

"Super Tested"



Vacu-Break SAFETY SWITCH with "CLAMPMATIC" CONTACTS

Sizes for Every Switch Job



You take no chances when you install BullDog equipment in your plant. We "treat 'em rough" *before* they go to the customer.

The Vacu-Break Safety Switch, for example, has met every type of punishment we can devise in our own laboratories. This is why you can depend on the same BullDog *proved* quality every time, whether you need one safety switch or a whole battery.

Unique, quick action mechanism assures positive "ON" and "OFF" operation. "Clampmatic" contacts are tight as a bolted connection when closed, thus reducing heating. The exclusive Vacu-Break principle of arc extinction snuffs out dangerous arcs as quickly as they form.

DESIGNED TO STAY MODERN—capacities from 30 to 1200 amp. For types and sizes to meet your needs, consult your BullDog field engineer or write for descriptive bulletins.

BUY MORE BONDS

BULLDOG

SALVAGE PAPER

DETROIT 32, MICHIGAN.
In Canada:
BullDog Electric Products of Canada Ltd., Toronto.
Field Offices in All Principal Cities.

ELECTRIC PRODUCTS COMPANY



Also Manufacturers of
SafToFuse Panelboards—Switchboards—Circuit Master Breakers—Universal Trol-E-Duct, for flexible lighting—Industrial Trol-E-Duct, for movable "loads"—BUS-tribution DUCT, for "Plug-In" Power.

Via GraybaR —READY WITH A WIDER CHOI



Miles and Miles of MITCHELL *Lighting Serve Industry Today*

THIS WIDESPREAD POPULARITY HAS BUILT VOLUME BUSINESS AND GOODWILL FOR DISTRIBUTORS AND CONTRACTORS EVERYWHERE.

Across the country . . . in plants of all types . . . thousands of MITCHELL fluorescent fixtures work hour after hour . . . day after day. In single units. In continuous rows.

Because of MITCHELL-engineered lighting efficiency . . . employees *see* better . . . *feel* better . . . *work* better. Because of MITCHELL design . . . easier installation and maintenance *cut service costs* and *save manpower.*

For these very reasons . . . Distributors and Contractors find MITCHELL Lighting easier to sell . . . certain to satisfy.

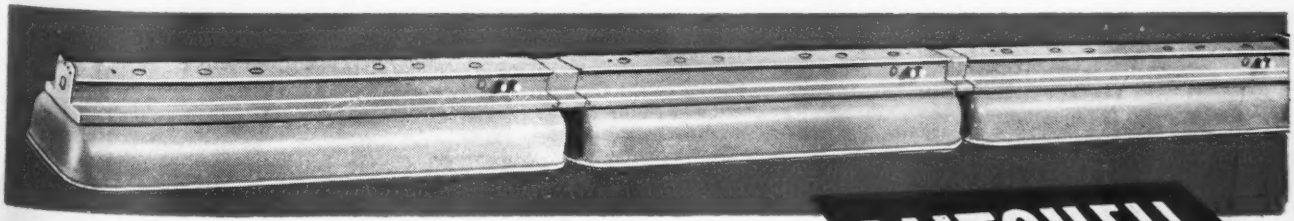
Tomorrow . . . MITCHELL accomplishments of today will mean *constant and growing* sales . . . *surer and greater* profits!

Makers of
Industrial and Commercial Fluorescent Lighting Equipment
Store Window Lighting • Spotlights and Floodlights
Desk Lamps • Portable Floor and Table Lamps
Bed Lamps • Ultraviolet and Infrared Health Lamps
Residential Lighting Specialties



USE THESE SALES AIDS!

Write for full-size Catalog No. 281 and Pocket-size Catalog No. 290. Each tells full story of industrial units . . . each builds sales.



Mitchell Manufacturing Company
2525 CLYBOURN AVENUE, CHICAGO 14, ILLINOIS
West Coast Factory and Sales Office: 1019 N. Madison Ave., Los Angeles 27, Cal.

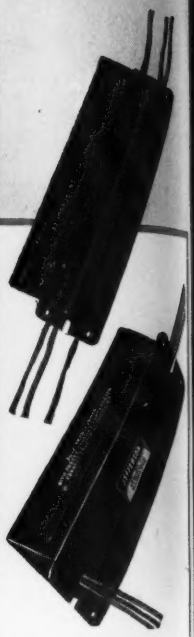
MITCHELL
FIRST IN POPULARITY

. . . TO BROADEN THE CONTRACTOR'S SERVICE

AIDS TO DEPENDABLE LIGHTING







BALLASTS FOR FLUORESCENT LAMPS

In the complete line of Jefferson Electric Ballasts, capacities and types for all commercially made fluorescent lamps are included. Correct engineering, control of all steps of production in our own plant, equipment and facilities not matched anywhere—insure highest uniform quality and quiet operation, and long life.

Jefferson Electric Ballasts are now available in two-lamp 40-watt sizes designed to bring leads either from the ends or bottom, the latter particularly suited to mounting on narrow wiring channels. This type of Ballast reduces the number necessary to carry in stock.

All types of Jefferson Electric Ballasts are acceptable by lamp manufacturers for operation of their products as evidenced by the E.T.L. certification.

The Jefferson Electric Ballast for cold-cathode use incorporates a transformer, two reactors and a capacitor. This Ballast lights two 40-watt tubes with a power consumption of 105 watts and operates from the ordinary 115 volt alternating current lighting system. Separate attachable junction boxes are made for use where required.

As innovations and new ideas in tubing will be introduced, Ballasts for their operation will be made available.

JEFFERSON-UNION RENEWABLE FUSES





Unnecessary shutdowns and damage to motors, wiring and equipment can be eliminated with proper fusing. When excessive overloads require Jefferson Renewable Fuses to open the circuit, they do it safely. Rugged construction and simple design assure quick cleaning, easy renewal and long years of service. With the latest fuse link assembly and automatic compensation for contraction and expansion—secure assembly and knife blade alignment are always assured.

Jefferson-Union Renewable Fuses have been known for their uniform accuracy and reliability since the earliest days of the electrical industry.

JEFFERSON ELECTRIC

JEFFERSON ELECTRIC COMPANY • Bellwood (Suburb of Chicago), Illinois

IN CANADA: CANADIAN JEFFERSON ELECTRIC CO. LTD., 384 PAPE AVENUE, TORONTO, ONT.

Via Graybar —READY WITH A WIDER CHOI

HERE ARE YOUR TRUMPS
for the Business of Tomorrow!



You Win EVERY TIME *with* Revere

The COMPLETE QUALITY LINE

"More outstanding than ever" that is the Revere achievement in Service Station lighting. Being pioneers in the development of Standardized Lighting Equipment for the nation's Automobile Service Stations and with the resumption of peace-time production of Alzak Aluminum Open and Enclosed Floodlights—Hinged Floodlight Poles—Low Mounting Standards—Rigid Floodlight Poles—you have the widest line to choose from . . . offering you better engineering—greater efficiency, easier wiring and maintenance—all of which means greater saleability. Our new General Catalog is in the making. Reserve your copy now.

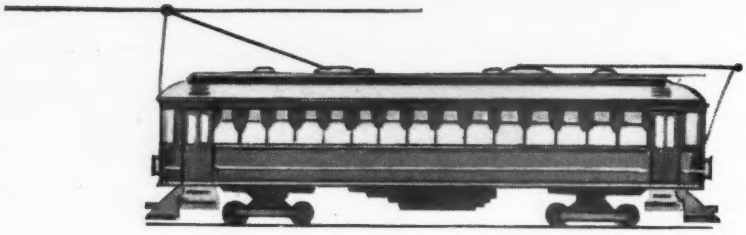
REVERE ELECTRIC MFG. CO.

6017 BROADWAY CHICAGO 40, ILLINOIS

INDOOR AND OUTDOOR LIGHTING EQUIPMENT FOR • SERVICE STATIONS • AIRPORTS • INDUSTRIAL • MARINE • SPORTS

. . . TO BROADEN THE CONTRACTOR'S SERVICE

LIKE THE TROLLEY CAR



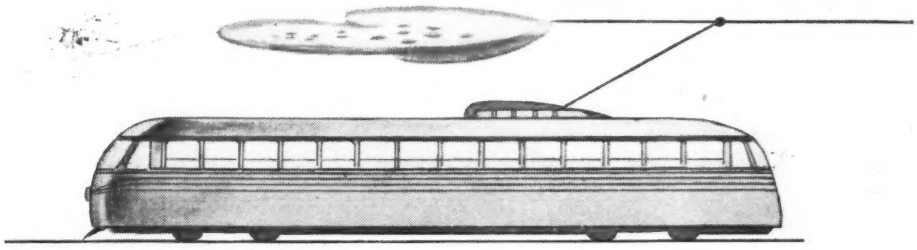
Electrical Raceways



The ELECTRUNITE BENDING SYSTEM, consisting of: (1) "Inch-Marking" along the entire length of every piece of tubing, (2) The ELECTRUNITE BENDER—a one-piece casting containing built-in instructions for use, and (3) A Bending Instruction Tag which accompanies every shipment, makes ELECTRUNITE E. M. T. the world's easiest-to-install rigid steel conduit.

Via GraybaR —READY WITH A WIDER CHOI

have gone modern, too!



REPUBLIC ELECTRUNITE E.M.T. — The Streamlined Wiring Raceway — HELPS KEEP INSTALLATION SCHEDULES ON TIME

EASE of INSTALLATION—plus-factor of Republic ELECTRUNITE E.M.T. which keeps jobs moving on schedule—is a mighty important reason why more and more cost-wise electrical contractors and industrial maintenance men are using this *modern* steel conduit.

Here are the facts—

First: ELECTRUNITE E.M.T. is threadless—requires no tedious thread cutting. With compression-type fittings, strong, water-tight joints are made quickly and easily with only a pair of pliers.

Second: ELECTRUNITE E.M.T. is the only steel conduit that's "Inch Marked" for easier, accurate bending. With the patented one-piece ELECTRUNITE BENDER, all types of saddle and offset bends may be made quickly and efficiently, by following directions contained on the Bending Instruction Tag which accompanies every shipment of ELECTRUNITE E.M.T.

Third: ELECTRUNITE E.M.T. weighs less than half as much as conventional, threaded conduit . . . . greatly simplifies installations in overhead and difficult-to-reach locations.

Fourth: ELECTRUNITE E.M.T. speeds up wire pulling operations. Its patented knurled inside surface reduces cable drag and makes wire pulling as much as 30% easier.

Of course, ELECTRUNITE E.M.T. meets building safety requirements, too. Its inspection by Underwriters' Laboratories and approval by The National Electrical Code for installation in exposed, concealed or concrete slab construction is your assurance that it provides adequate mechanical and electrical protection.

For more information on these and other advantages offered by Republic ELECTRUNITE E.M.T. see your nearest ELECTRUNITE Distributor.

REPUBLIC STEEL CORPORATION
STEEL AND TUBES DIVISION • CLEVELAND 8, OHIO
Export Department: Chrysler Building, New York 17, N. Y.

REPUBLIC STEEL — SERVES THE WORLD

Republic

ELECTRUNITE E.M.T.

REG. U. S. PAT. OFF.

LIGHTWEIGHT THREADLESS RIGID STEEL CONDUIT

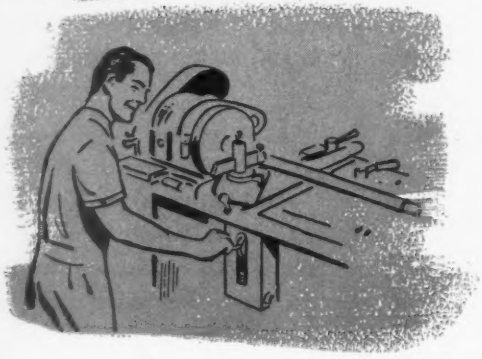
. . . TO BROADEN THE CONTRACTOR'S SERVICE

Here's a Switch that Workers Like











Shutlbrak

ENCLOSED SWITCH

In capacities to fit *every* job from 30 to 1200 amperes, for 250 volts AC or DC, and 575 volts AC, in 2, 3, and 4 poles. For detailed specifications and prices, write for our 20-page Bulletin No. 70.

THERE'S something about (FA) Shutlbrak Enclosed Switches that workers who use them like. Some tell us it's the easy-to-spot red plastic handle and the feeling of safety it has. Others say it's the split second speed of operation — even with a slow pull on the handle — that they like. Plant engineers tells us that they're *trouble-free* and sturdy, and that's the highest compliment we strive to merit.

The next time your plant needs operating switches, whether for on and off once a day or for continuous switching, ask your electrical jobber to show you the (FA) Shutlbrak. The switch with a faster than the eye shuttle movement... silver on copper contacts that actually improve with use ... (FA) Kamklamp pressure type fuseholders... and a fuse compartment that can only be reached when the switch is off.

EST. 1891 — THE SIGN OF A FA BETTER JOB

Frank Adam

ELECTRICAL PRODUCTS

FRANK ADAM ELECTRIC CO. ST. LOUIS, MO. U.S.A.

Manufacturers of . . . . SWITCHBOARDS, PANELBOARDS, BUSDUCT, SWITCHES

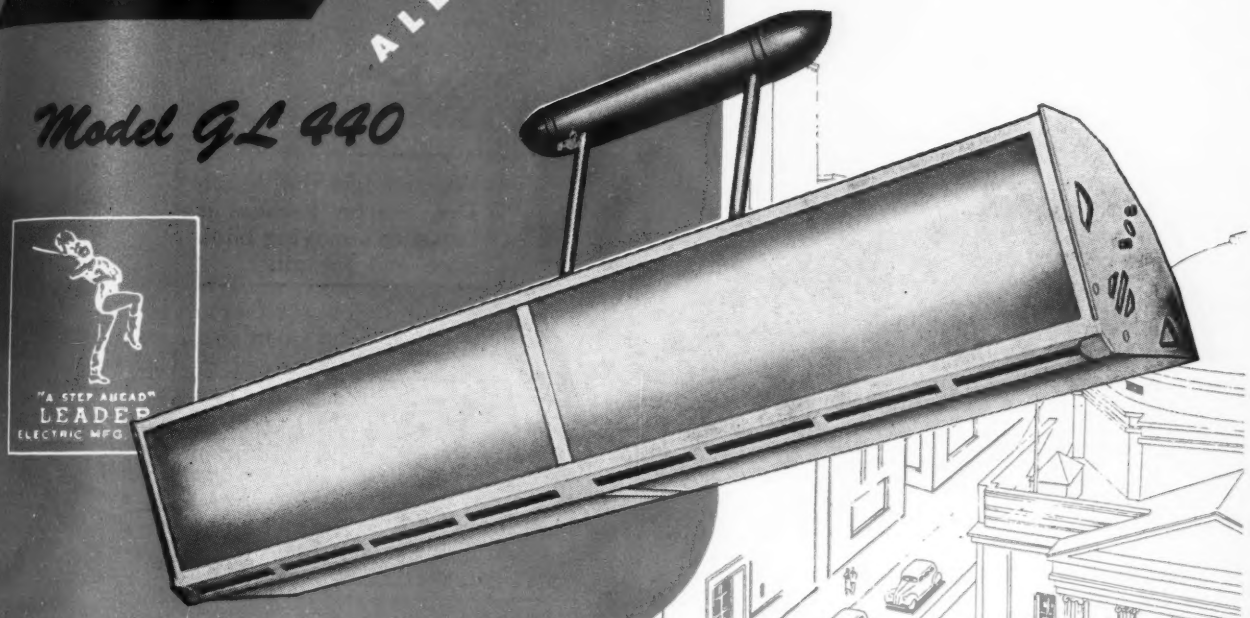
Via Graybar —READY WITH A WIDER CHOI

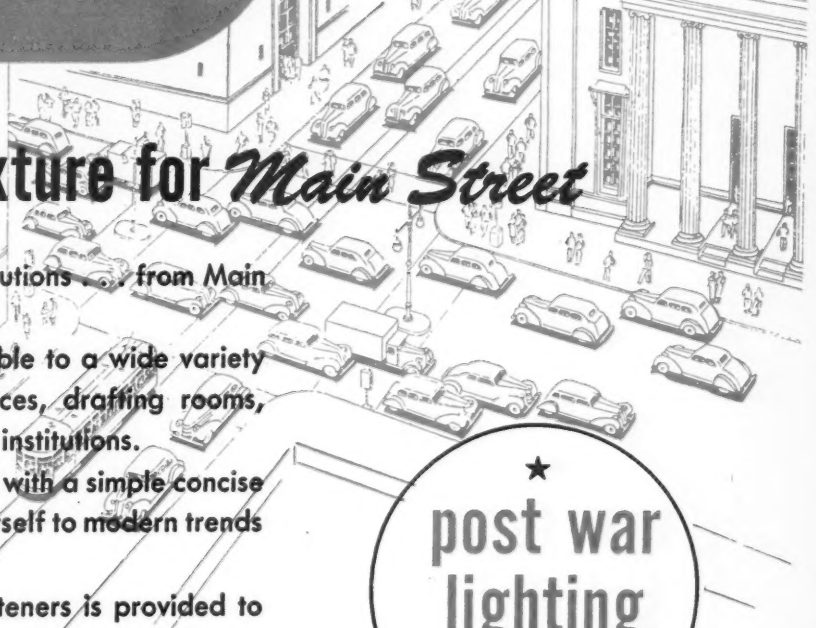
Leader

ALL PURPOSE

COMMERCIAL FIXTURE

Model GL 440





a fluorescent fixture for *Main Street*

Designed for offices, stores, institutions . . . from Main Street to Broadway.

The Leader GL 440 is adaptable to a wide variety of installations, particularly, offices, drafting rooms, schools, stores, banks and other institutions.

A four light glass enclosed unit with a simple concise design, the Leader GL 440 lends itself to modern trends in architecture and lighting.

A hinged panel with snap fasteners is provided to facilitate relamping and servicing. Easy to install either in individual or in continuous run, flush mounted or hung from stems and canopies.

Distributed only through the better electrical wholesalers.

★ post war lighting *Now!*

There is a Leader representative in your area

Leader Electric Manufacturing Corp.

6127 North Broadway, Chicago 40, Illinois

West Coast Factory:
2040 Livingston Street • Oakland 6, California

. . . TO BROADEN THE CONTRACTOR'S SERVICE

A Complete Line of G-E

Watch Dog STARTERS

REG U S PAT OFF

For 15- to 100-watt Fluorescent Lamps

For several years G-E Watch Dog Fluorescent Starters have been protecting fluorescent lighting units in countless commercial and industrial installations all over the nation. These manual reset starters have gained fine acceptance because they've helped to save many man-hours of maintenance. They have two other outstanding features—precision lamp starting and positive dead lamp stopping. Recently General Electric introduced the new FS-20 which completes its line of Watch Dog Starters. Now, there's a starter for 15-, 20-, 30-, 40-, and 100-watt lamps.

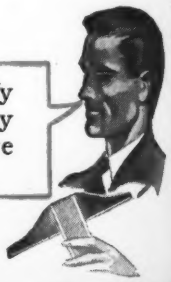
There are many reasons why more and more people are switching to G-E Watch Dog Starters. Above are typical reasons why these three prefer G.E.



BALLASTS • LAMPS • STARTERS • LAMPHOLDERS • WIRE



Workers like the Watch Dog Starter because it banishes annoying blink once and for all.



Lighting engineers specify Watch Dogs because they outlast the life of five ordinary starters.



The Watch Dog is the maintenance man's loyal helper. To relamp, reset it . . . forget it.

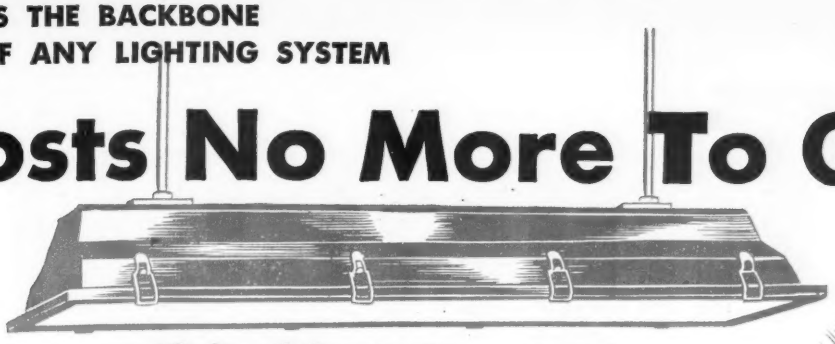
Get the whole story about how to use fluorescent accessories for best lighting results by writing to Section G1152-8, Appliance and Merchandise Department, General Electric Company, Bridgeport, Conn.

GENERAL ELECTRIC

Via Graybar —READY WITH A WIDER CHOI

THE REFLECTOR IS THE BACKBONE
OF ANY LIGHTING SYSTEM

It Costs No More To Get



Skilled Lighting

When you get going on those war-delayed renovations in plant lighting, why not make sure that the system you install will be a *permanent plant improvement?*

A high-intensity lighting system equipped with Wheeler Fixtures costs no more than other modern systems, yet it gives you Skilled Lighting that pays dividends in high worker-output, improved product-quality, lower accident rates and better morale *for years to come!*

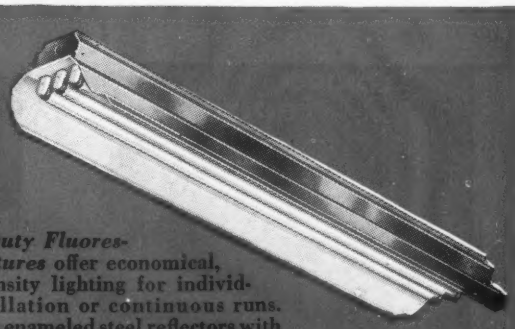
Wheeler Lighting is *skilled lighting* because it's designed with the know-how and vision of engineers who have specialized in good lighting for more than 60 years. It is quality equipment . . . built to highest RLM standards of construction, durability and light-output.

Write for details of Wheeler's complete line of Incandescent and Fluorescent Fixtures for industries. Wheeler engineers will be glad to help you plan correct layouts. **Wheeler Reflector Company, 275 Congress Street, Boston 10, Mass.** Also New York. Representatives in principal cities.

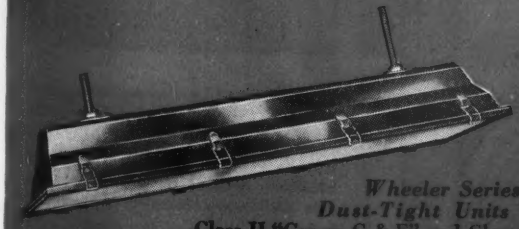
DISTRIBUTED EXCLUSIVELY THROUGH ELECTRICAL WHOLESALERS



Wheeler Incandescent Fixtures for any industrial use. RLM Solid Neck Standard Dome is only one of many types. Complete range of standard shapes . . . dome, angle, etc. Provide maximum lighting efficiency for lamps from 75 watts to 1500 watts.



Wheeler Heavy Duty Fluorescent Fixtures offer economical, high-intensity lighting for individual installation or continuous runs. Porcelain enameled steel reflectors with high reflection efficiency. Made for two 40-watt, three 40-watt and two 100-watt lamps.



Wheeler Series II Dust-Tight Units for Class II "Group G & F" and Class III and IV Hazardous Locations. Hinged cover protects lamps from dust and vapors. Supplied with Double-Thick Plain Clear Glass, Water-White Plate Glass or Tempered Clear Safety Plate Glass.



Wheeler Vapolux Reflectors for incandescent lighting in hazardous locations. Dust-tight and vapor-proof . . . highly durable and easy to install and service. Made in standard styles for lamps from 100 watts to 500 watts.

Wheeler REFLECTOR COMPANY

LIGHTING EQUIPMENT SPECIALISTS SINCE 1881

. . . TO BROADEN THE CONTRACTOR'S SERVICE

TRUMBULL

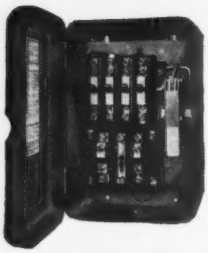
ELECTRICAL DISTRIBUTION AND CONTROL

for Light and Power

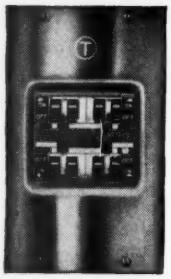
HEAVY DUTY INDUSTRIAL SWITCHES



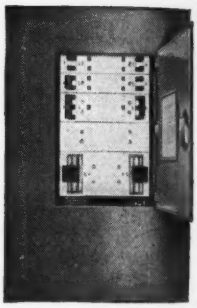
MAGNETIC STARTERS



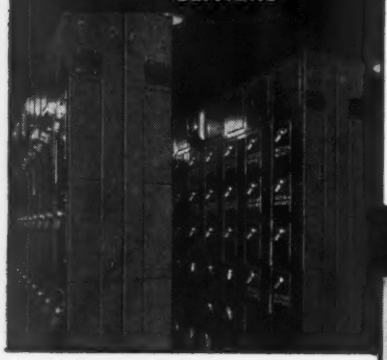
MULTI BREAKERS



PANEL BOARDS ALL TYPES



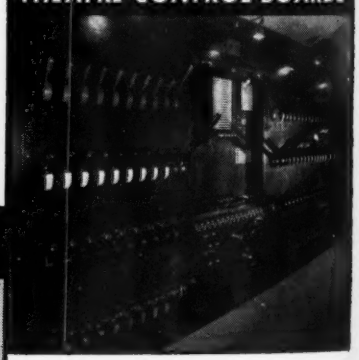
CONTROL CENTERS



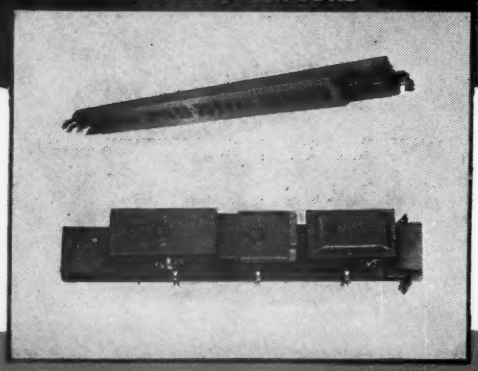
RAYMERSION OVENS



CONTROLITE *THEATRE CONTROL BOARDS*



BUSS-WA FLEX-A-POWER TROLLEY CLOSURE



Trumbull apparatus, pioneered, developed and expanded since the early years of the electrical industry, includes a wide variety of Distribution and Control equipment of time-tested acceptance and dependability.

Introduced during the current year is a new Trumbull development . . .

"Raymersion," a standardized, pre-fabricated, Infrared Oven for industrial drying and baking. Its quick acceptance parallels that of many other Trumbull products available through our many fine distributors located in the principal industrial centers of the country.

THE TRUMBULL ELECTRIC MANUFACTURING CO.

PLAINVILLE, CONNECTICUT

OTHER FACTORIES AT

NORWOOD (CINN.) OHIO— LOS ANGELES—SAN FRANCISCO—SEATTLE

Via GraybaR —READY WITH A WIDER CHO

"first—"

AGAIN, AS IN THE PAST, SIMPLEX COMES UP WITH ANOTHER *first* THIS TIME WITH FLAME-RESISTING TIREX PORTABLE CABLES.

ALL TIREX CABLES ARE NOW *Flame* RESISTING

In addition to the famous Selenium Rubber Armor which protects all Simplex-TIREX cables, flame-resistance has been added to the Selenium Rubber Armor with no reduction in its wearing quality.

TIREX SELENIUM Rubber Armor
Unequalled for Long-Life Toughness and Resistance to Abrasion.

When you need portable cables again, remember that Simplex-TIREX cables combine the latest advances in both manufacturing and technical skill.

THE BEST THINGS IN CABLE CONSTRUCTION COME FROM SIMPLEX FIRST

Simplex Wire & Cable Co., 79 Sidney Street, Cambridge 39, Mass.

ARMY E NAVY

Simplex WIRES and CABLES

. . TO BROADEN THE CONTRACTOR'S SERVICE

How you can use these *BIG, TOUGH* Mossman Switches to do the job right... at a *PROFIT*



MOSSMAN Series 4100 Heavy Duty Lever Switch

A heavy duty, multiple circuit, positive action lever switch, with the great flexibility of circuit arrangements characteristic of all Mossman switches. Available in either 3-position (4101) or 2-position (4102) in an almost unlimited series of combination of contact assemblies, which may be built up to suit specific requirements. Contact ratings include: Standard Heavy Duty . . . $\frac{3}{16}$" diameter, fine silver, 10 amperes, 110 volts A.C. (non-inductive); Extra Heavy Duty . . . $\frac{5}{16}$" diameter, silver alloy, 20 amperes, 110 volts A.C. (non-inductive).

ASK the Graybar man about Mossman heavy duty multiple circuit switches. He'll tell you some of the many places to use these big, rugged switches. He'll tell you how they are heavy-duty built, for safety and durability, for sure, long-life positive operation. He'll help you select the right switch from the Mossman line of multiple circuit switching components.

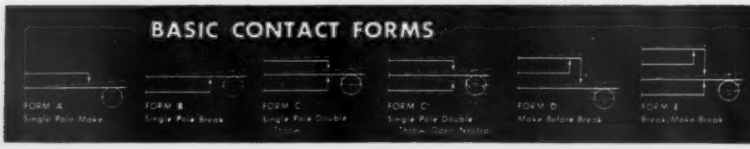
This line includes heavy duty lever, turn and push switches, plug jacks, and other special devices. A wide variety of sizes, styles, pile-ups, and contact arrangements is available. These components have proved their dependable performance and profit possibilities in industrial plants, railroads, and other installations.

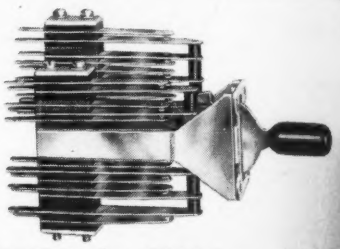
Ask the Graybar man for details, or write for the Mossman catalog-data book.

DONALD P. MOSSMAN, INC.
612 North Michigan Avenue **Chicago 11, Illinois**

MOSSMAN
"Electrical" Components

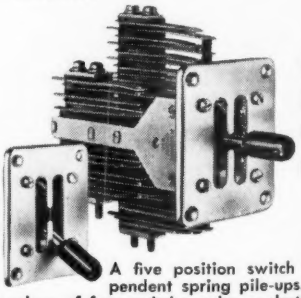
Any combination of these contact forms is available.





MOSSMAN Series 4200 Lever Switch

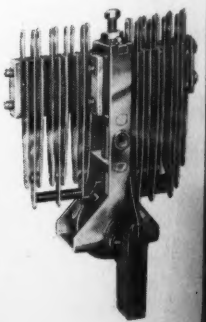
Similar to Series 4100, but lighter and smaller. Frame of either zinc or aluminum die casting. Like the Series 4100, the 4200's are available as either a 3-position (4203) or 2-position (4202) switch. Contact ratings include: Standard Heavy Duty . . . $\frac{1}{16}$" diameter, fine silver, 5 amperes, 110 volts A.C. (non-inductive): Extra Heavy Duty . . . $\frac{3}{16}$" diameter, fine silver, 10 amperes, 110 volts A.C. (non-inductive).



MOSSMAN Series 4500 Heavy Duty Lever Switch

A five position switch with four independent spring pile-ups. May take the place of four switches where selectivity is required. Prevents the danger of throwing more than one switch at a time. Lever action may be changed at any time by selecting proper stop plate. Choice of locking or non-locking in all positions except center or neutral position which is always locking. Circuit arrangements and contact ratings are the same as Series 4100.

MOSSMAN Series 6300 Heavy Duty Turn Switch



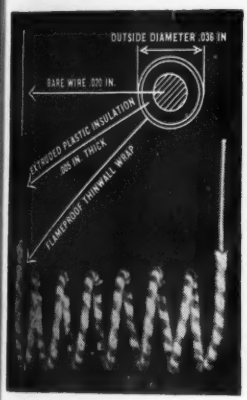
Same frame construction and operating flexibility as the Series 4100 Switch. Extra long bushing and gland nut for moisture-proof mounting. Also available with extra long shaft for mounting on a bracket back of other components. Same contact ratings as Series 4100 Switch.

SURCO PLASTIC INSULATING TUBING and INSULATED WIRE PRODUCTS

TUBING

Your particular insulating tubing specifications or qualities can be filled exactly, by Surprenant. Every Surco formulation is rigidly tested for temperature extremes, non inflammability, ageless durability, maximum flexibility, proof against moisture, all kinds of weather, dilute acids, oils and most solvents. Available in continuous lengths, from .005 to 2" I. D. Surco formulations are non fogging, highly insulating and abrasion resistant, clear and in all colors, with dielectric strength which averages 1500 volts per mil. thickness.



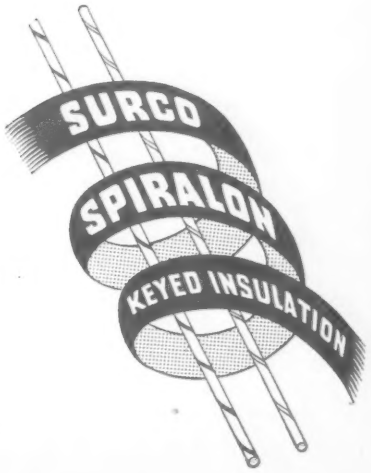


THINWALL . . .

. . . an unbelievably thin and uniform plastic insulated fine wire with flame proofed yarn serving, among other qualities, possesses high dielectric properties, maximum saving in space and weight, unlimited coding and identification, unusual flexibility and good end and spot stripping characteristics. Voltage breakdown — 7000 volts.

SPIRALON KEYED INSULATION . . .

. . . a spiral striped plastic insulated wire, offers the widest range of tracer code identification. Avoids use of color pigments. Primary covering retains full insulation resistance. With a high heat, low temperature Nylon Jacket added, Spiralon reduces weight, permits smaller O. D., increases fungi and abrasion resistance, eliminates covering voids, resists creepage and age deterioration.



SHIELDED WIRE • VINYL RESIN SHEETING
HIGH FREQUENCY WIRE and CABLE • INSULATING TAPE

Surprenant ELECTRICAL INSULATION CO.

ADDRESS DEPT. AA 84 PURCHASE ST. BOSTON, MASSACHUSETTS, U. S. A.

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PROTECTION WITH ECONOMY

Wise buyers have protected their circuits and installations with ECONOMY ever since 1911. Not only has ECONOMY pioneered in fuse invention and development, but has constantly improved the quality, performance and dependability of ECONOMY Fuses and "Drop Out" Renewal Links.

Available from stock in both ferrule and knife blade types.

OTHER TIME-TESTED ELECTRICAL FUSES
Arkless ... Clearsite ... Eco Midget ... Arkless Midget

SOLD THROUGH JOBBERS EXCLUSIVELY SINCE 1911: First to be approved by Underwriters Laboratories, Inc.

Protection WITH ECONOMY

Time-Tested • Reliable • Safe

REPRESENTATIVES IN ALL PRINCIPAL CITIES

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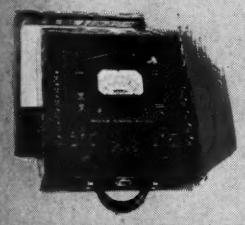
ECONOMY Fuse and Mfg Co.

2717 N. Greenview Ave., Chicago 14, Illinois

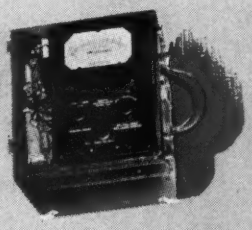
via GraybaR —READY WITH A WIDER CHO

Instruments FOR ALL PROBLEMS OF RECONVERSION

Utilities, manufacturers and maintenance contractors will find, within the broad WESTON line, instruments specifically suited to *all* problems of electrical reconversion . . . whether they involve quick repairs, rewiring for heavier loads, relocation of equipment, new testing stands or laboratory installations, improved lighting, as well as for all electrical and electronic maintenance needs. Literature, or engineering cooperation on any instrument problem, is freely offered. Weston Electrical Instrument Corporation, 578 Frelinghuysen Avenue, Newark 5, N. J.



(MODEL 785) INDUSTRIAL CIRCUIT TESTER . . . the most versatile portable tester for laboratories, and plant maintenance, where an ultra-sensitive instrument is required. Provides 27 AC and DC voltage, AC and DC current, and resistance ranges. (dc sensitivity 20,000 ohms per volt.)



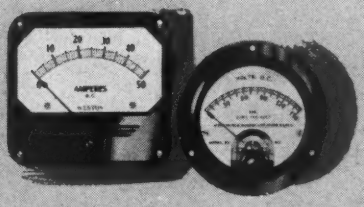
(MODEL 796) INSULATION TESTER . . . a direct-reading self-contained resistance tester that eliminates hand cranking. Tests up to 200 megohms at test potential of 350 to 500 volts dc., current at terminals only a few microamperes. Ranges 0-20-200 megohms, full scale . . . 0-.5-5 center scale.



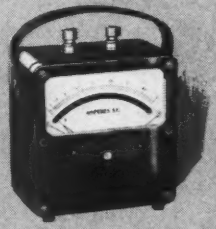
(MODEL 697) VOLT-OHM-MILLIAMMETER . . . combines a selection of AC and DC voltage, direct current, and resistance ranges in a pocket-size meter. Ideal for maintenance testing and inspection needs.



(MODEL 633) AC CLAMP AMMETER . . . for quick, easy current measurements on insulated or non-insulated conductors. The clamping jaws are simply clamped around the conductor, and readings taken. Circuits are never disturbed. A real time saver in electrical maintenance.



PANEL AND SWITCHBOARD INSTRUMENTS . . . available for all AC and DC requirements, in all types, sizes and ranges. The complete line is fully described in the WESTON Panel Instrument bulletin. Send for your copy.



(MODEL 430) AC AND DC TEST INSTRUMENTS . . . combine dependability, ruggedness, compactness and scale readability. Equipped with hand calibrated, mirror scales. Available for AC and DC requirements, and as DC and single-phase AC Wattmeters.



(MODEL 703) SIGHT METER . . . direct-reading, pocket size meter calibrated to measure light values in foot-candles, or by seeing tasks. Equipped with the WESTON VISCOR* filter, it measures all light values direct, without correction factors.

Weston *Instruments*

ALBANY • ATLANTA • BOSTON • BUFFALO • CHICAGO • CINCINNATI • CLEVELAND • DALLAS • DENVER • DETROIT • JACKSONVILLE • KNOXVILLE • LOS ANGELES • MERIDEN
MINNEAPOLIS • NEWARK • NEW ORLEANS • NEW YORK • PHILADELPHIA • PHOENIX • PITTSBURGH • ROCHESTER • SAN FRANCISCO • SEATTLE • ST. LOUIS • SYRACUSE

In Canada, Northern Electric Co., Ltd., Powerlite Devices, Ltd.

. . . TO BROADEN THE CONTRACTOR'S SERVICE

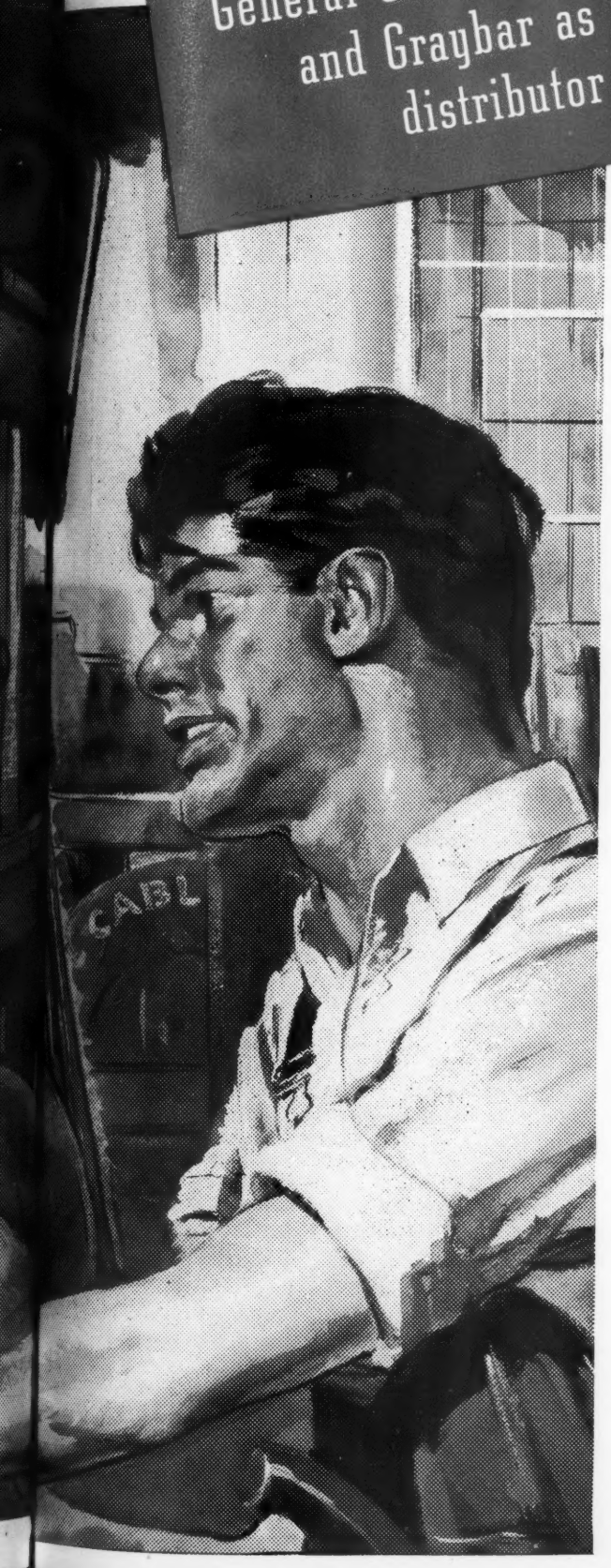
FULL SPEED AHEAD-N



Via GraybaR —READY WITH A WIDER CHOI

D-NOW

General Cable as a manufacturer and Graybar as an important distributor are ready to go.



First in the wartime attention of General Cable and Graybar has been the vast needs of America's armed forces and essential industries.

Now attention is directed to the huge backlog of civilian construction requirements. The General Cable-Graybar partnership will continue in serving these needs.

For General Cable, it is a change of objective or end use. Its war-born skills and techniques are now being applied to civilian goods. Its expanded wire and cable production facilities, research, development and engineering are serving the same purpose. All are being utilized to fill industry's building needs.

For Graybar, it is a continuance of its distinguished service as one of America's major sources of supply for everything electrical.

GENERAL CABLE
CORPORATION

Manufacturers of Bare and Insulated Wires for Every Electrical Purpose

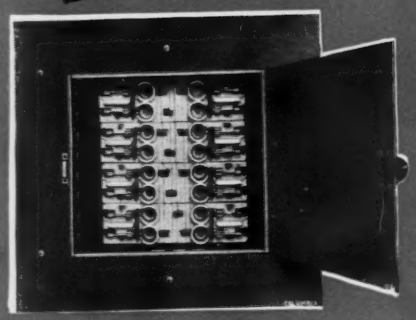
. . . TO BROADEN THE CONTRACTOR'S SERVICE

When you install Columbia-Quality Steel Products . . . via Graybar, you are assuring yourself of two things:

1. **Customer-satisfaction**
2. **Savings in time spent solving difficult installation problems.**

Here's why: Columbia Metal products are engineered to include Underwriters' requirements for strength, design and weather conditions, and you have a wider choice of standardized styles and sizes for speedier service. Also, we are equipped to manufacture special sizes to your specifications.

Call your nearby Graybar Inside Construction Specialist. He'll be glad to help you in every way possible on wiring or delivery problems.



GUTTERED TYPE CABINETS

Special switches can be made. Give arrangements of cutouts and switches, size of gutter frame and cabinet.



WEATHERPROOF CABINETS

For wet locations and outdoor service. Constructed to keep out beating rain and moisture. Protected against corrosion.

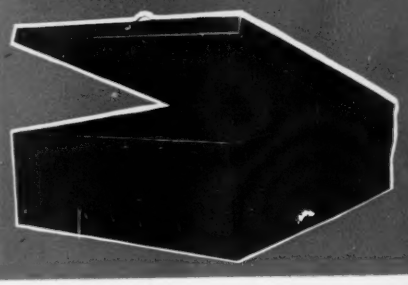
SCREW COVER PULL BOXES

Can be supplied in any thickness of steel and in every size required. We are equipped to make special pull boxes of any design, size and specification.



TYPE "A" SURFACE CABINETS

This style of cabinet is adaptable to nearly all installations where a cabinet for surface mounting is required to be used as a junction, service, switch, panel, or cutout cabinet.



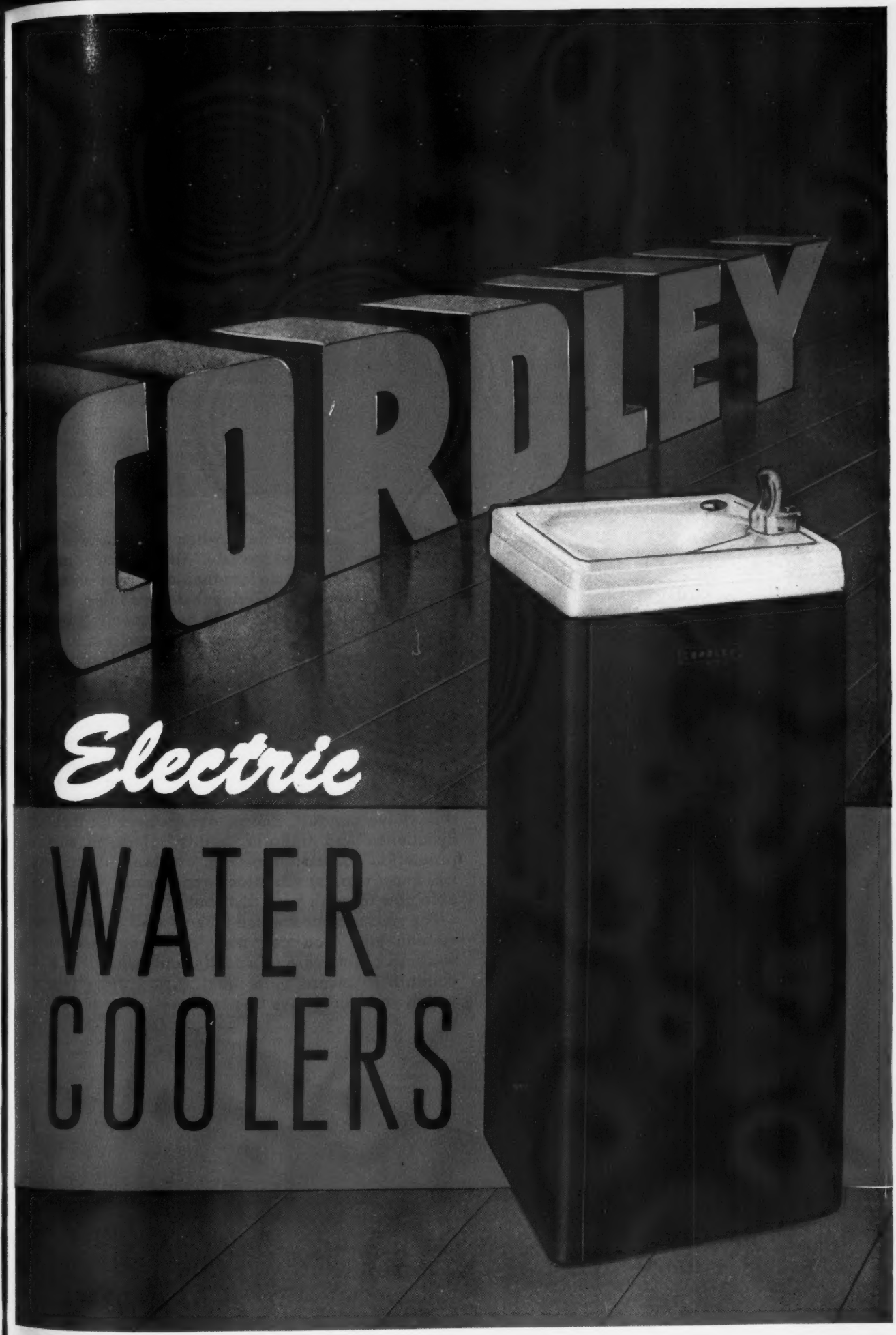
Outstanding reasons for the wide acceptance of Columbia quality products are found in their high grade construction, ease of operation, flexibility, safety, and above all, their established reputation for dependability.

Behind all Columbia quality products this is the first consideration—they are designed and built to give the best possible service for the particular application. Satisfaction is the definite reaction, country - wide, wherever there are installations of Columbia quality steel products.

COLUMBIA METAL BOX CO.

260 EAST 143RD ST. NEW YORK 51, N. Y.

Via Graybar —READY WITH A WIDER CHOICE



. . . TO BROADEN THE CONTRACTOR'S SERVICE

FOR SAFETY'S SAKE . . . USE CONDUIT *(Full Weight Rigid Steel)*



- Makeshift Wiring Methods are "OUT" for Reconversion

BACK in the days when America was producing "too little and too late," the electrical industry had to accept certain less-than-excellent practices for wiring buildings. Codes that have insured safety under all conditions had to be suspended in the face of dire emergency. But, of course, plants with this emergency type of wiring were designed to operate that way only a few years at most.

Today, America is thinking about converting these plants to permanent peacetime use. So it is extremely important that all temporary wiring systems be converted, too--through replacement with permanent, full-weight, standard-threaded, rigid steel conduit systems.

Buckeye conduit, known everywhere for its high excellence and uniform quality, gives maximum protection against tampering, crushing, dust, dirt, moisture, vapors, vibration, explosions. It is available now through your distributor.

For your new peacetime jobs, as well as for reconversion jobs, you can now throw out makeshift wartime practices and specify and use BUCKEYE conduit, to insure permanent wiring protection of which you can always be proud.



QUALITY TRADE MARK YOUNGSTOWN SERVICE

YOUNGSTOWN

THE YOUNGSTOWN SHEET AND TUBE COMPANY

YOUNGSTOWN, OHIO

Manufacturers of

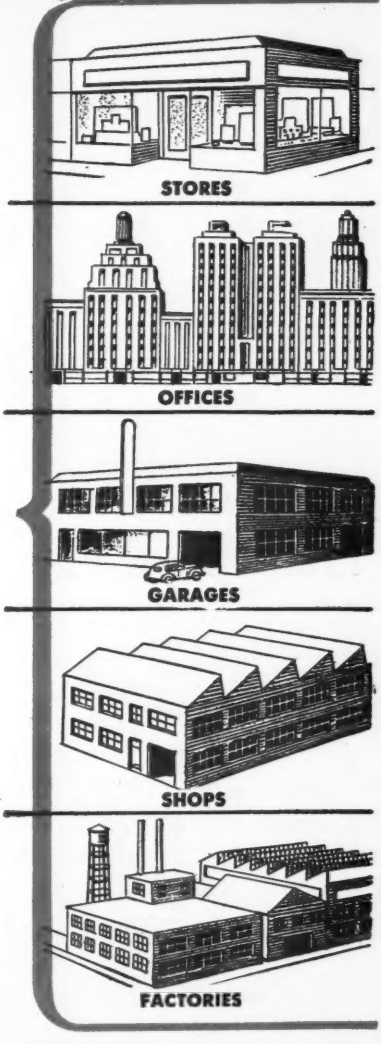
CARBON - ALLOY AND YOLOY STEELS

Ask your distributor for:
Youngstown Buckeye Conduit...Pipe and Tubular Products...Sheets...Plates...Electrolytic Tin Plate...Coke Tin Plate...Bars Rods...Wire...Nails...Tie Plates and Spikes

Via Graybar —READY WITH A WIDER CHOI

We expect to sell all the Teletalk Equipment we can get"





NEVER BEFORE has there been such an opportunity to sell Teletalk

Postwar competition is here. Every business today must increase its efficiency and give better customer service to meet this new condition. Teletalk is "tailor-made" for this purpose. It fits right into the postwar need. Teletalk is a modern electronic voice-to-voice method of intercommunication between individuals and departments. It speeds up the whole tempo of a business. Where can you find a product more useful to business right now? The opportunity to sell Teletalk is tremendous. Practically every bank, store, garage, office, shop or factory, right in your own locality, is a prospect for Teletalk. Why not get your share of this business?

Easy to Sell . . . You Make Two Profits

Teletalk practically sells itself when you demonstrate its efficiency . . . how it conserves time, saves steps, avoids delays, and improves customer service. Teletalk is nationally advertised and widely known. Prospects are receptive to Teletalk. *Getting orders is a matter of making contacts.* Every sale earns two profits . . . one on Teletalk equipment . . . the other on the wiring and installation. Oftentimes, the sale of Teletalk leads to other business in your line. Don't pass up these sales and profit opportunities.

Let the Graybar Man Help You

Ask the Graybar man in your locality to help you contact prospects. He will gladly work with you. Get your share of this profitable Teletalk business NOW.

•

In addition to Teletalk Intercommunication Systems, Webster Electric makes Teletalk Paging Systems, Sound Distribution Systems, and Dispatching Systems for industrial and railroad use.

Licensed under U.S. Patents of Western Electric Company, Incorporated, and American Telephone and Telegraph Company.

ARMY ★★ NAVY **KEEP ON BUYING BONDS**

WEBSTER ELECTRIC

Racine, Wisconsin, U.S.A. • Established 1909 • Export Dept.: 13 E. 40th Street, New York (16), N. Y. Cable Address "ARLAB" New York City

"Where Quality is a Responsibility and Fair Dealing an Obligation"

. . . TO BROADEN THE CONTRACTOR'S SERVICE

Save time, materials and money on every job—with Greenlee Tools



HYDRAULIC BENDER FOR CONDUIT, TUBING, BUS-BARS

One-man-operated to make smooth, accurate bends quickly in rigid and *thin-wall* conduit, pipe up to 4½", tubing and bus-bars. No kinking, wrinkling or other damage to conduit.

Easily pays for itself the first few times used through valuable savings of your time, manpower and materials.

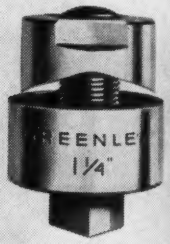
Two models—No. 770 for conduit up to 3"; No. 775 for sizes up to 4½". Compact, portable . . . for on-the-job bending. Small GREENLEE Hand Benders also available for steel, copper, brass and aluminum tubing up to ¾".

Get Ready with Greenlee!

REGISTERED TOOLS

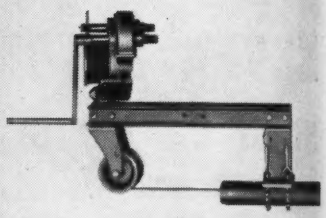
GREENLEE

FOR THE CRAFTSMAN



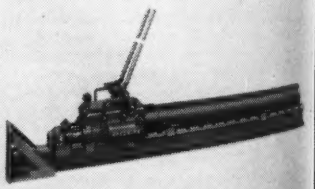
KNOCKOUT TOOLS

Eliminate drilling and filing to enlarge holes. In 1½ minutes or less cut openings up to 3½". Just insert in knock-out or small hole and turn with wrench.



CABLE PULLER

Simple operating, compact unit for 7,500 pound pull. Fastens direct to conduit to allow pulling in line with conduit . . . no hanger loosening. Two speeds to do the job quickly, easily, correctly!



HYDRAULIC PIPE PUSHER

Pushes pipe under streets, sidewalks, lawns, railroads, flooring and other obstacles. Eliminates tearing up, backfilling, re-paving. Two models: No. 790 for pipe ¾ to 4-inch; No. 795 for larger ducts and pipe. Hand or power-pump operated.

Write for free circulars on these or other GREENLEE timesaving tools for electrical work. Greenlee Tool Co., Division of Greenlee Bros. & Co., 1751 Columbia Avenue, Rockford, Illinois., U. S. A.

Via Graybar —READY WITH A WIDER CHOI

COFFING'S "Super-Man" SAYS:

"I may be a funny looking guy but I'm proud of my physique. My head is spurred for efficiency. My body is electrified with strength and energy. My arms and legs are powerful and untiring and can do all your lifting and pulling jobs with an ease that is astounding. For four years I have been working for Uncle Sam but now I'm free to work for you. Ask your supplier for further information regarding my qualifications and stamina."



Graybar
ELECTRIC COMPANY

Has Been a Distributor of

COFFING HOISTS

and Utility Maintenance Tools For Many Years

COFFING HOISTS AND UTILITY MAINTENANCE TOOLS are used by more than 86 per cent of the power, light, telephone and other Utility Companies in the U. S. A.

After four years of day and night production for the Armed Forces our products are again available to Electrical Contractors and other lines of industry. We are proud of the part COFFING products played in helping to restore Peace on Earth and we would like to thank our distributors and their customers for their patience, consideration and understanding during these trying war years.

Write for Folder No. EC-4

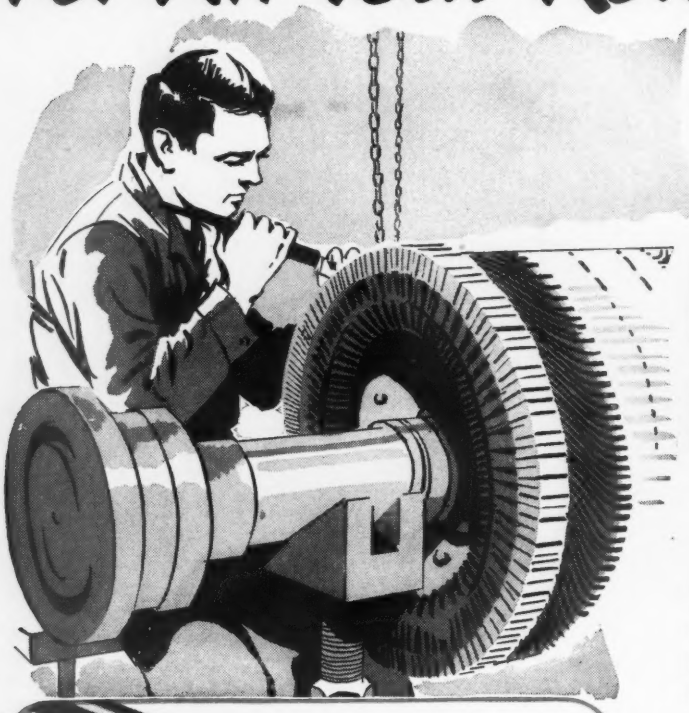
COFFING HOIST COMPANY

RATCHET LEVER HOISTS - SPUR GEAR HOISTS - ELECTRIC HOISTS
LOAD BINDERS - DIFFERENTIAL HOISTS - TROLLEYS

DANVILLE, ILLINOIS

. . . TO BROADEN THE CONTRACTOR'S SERVICE

For All Your Rewinding Jobs...



There's an Easy Handling, Fast Coiling

ROEBLING MAGNET WIRE

to Speed Your Service

Today, there's a big job to be done on over-burdened electrical equipment. To help you build new life and power, new efficiency, into war-wearied motors and transformers, there's a comprehensive choice of Roebling magnet wires . . . with just the right size, shape, and insulation you'll need.

From the substantial selection, you can choose a magnet wire that will balance with requirements for high operating temperatures; flexibility; resistance to abrasion, moisture, baking temperatures, unusual winding operations; space factor; dielectric strength and stability. Included are familiar types with fibrous or enameled coverings for standard rebuilding practices . . . Roeglas with fiberglas insulation . . . and Roevar, a new type synthetic enamel for unusually severe conditions, with a space factor that will permit you to put more turns into the coil spaces.

Roebling magnet wires—round, square, and rectangular—are all drawn of Roebling-milled, high-conductivity copper. Annealed under automatically controlled conditions, they're *uniformly* "dead soft" for that speedier forming that spells added profits.

JOHN A. ROEBLING'S SONS COMPANY

TRENTON 2, NEW JERSEY • *Branches and Warehouses in Principal Cities*





ROEBLING

PACEMAKER IN WIRE PRODUCTS

Via Graybar —READY WITH A WIDER CHOI



Planning now

. . . for the modernization of your industrial customers' electrical distribution and control systems, is good business. During the past few years, thousands of these systems have become inadequate in the face of vastly expanded production. Industry is going to need electrical efficiency more than ever before in the highly-competitive and narrow-margin days just ahead.

Your nearby Square D Field Engineer will be glad to work with you in developing some of this substantial modernization business.

SQUARE D COMPANY

DETROIT • MILWAUKEE • LOS ANGELES

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1ST

IN ··· QUALITY
ACCURACY
DURABILITY
PERFORMANCE
DEPENDABILITY
SAFETY FEATURES
EASY INSTALLATION
QUICK ADJUSTMENTS
SIMPLIFIED WIRING
UNFAILING SERVICE



MERCOID CONTROLS
used on a variety of industrial applications involving the control of Temperature, Pressure, Liquid Level Etc. ★ Hermetically sealed mercury switches used exclusively
WRITE FOR CATALOG

THE MERCOID CORPORATION · 4203 BELMONT AVENUE · CHICAGO · 41 · ILLINOIS

Via GraybaR —READY WITH A WIDER CHOI

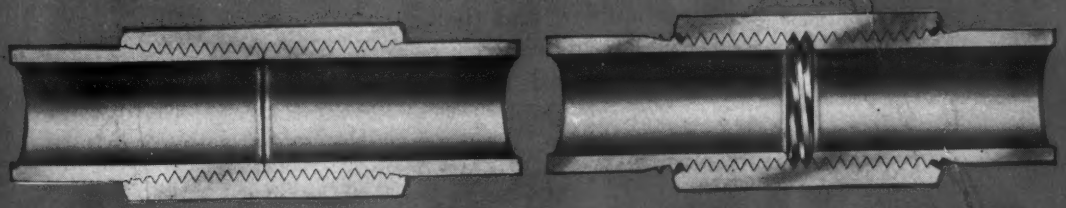


To Keep away from Rust

To Keep Wiring Safe

SHERARDUCT

Rigid Steel Conduit
with the
NE PROTECTIVE COUPLING



NE COUPLING—Sherardized rustproofed threads meet Sherardized rustproofed threads. No raw threads exposed.

ORDINARY COUPLING—Raw threads meet raw threads—accelerates rust. Threads exposed.

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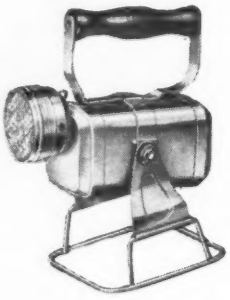
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IN OVER 80 PRINCIPAL CITIES

What Voltage for Industrial Plants

[FROM PAGE 65]

The total *extra cost* of the entire 2400 volt power system over a 4000 volt power system has been included at $4.00 per horsepower of high-voltage motor, i.e., $4.00 per horsepower was added to curve B to obtain curve D. This figure ($4.00) is arrived at by assuming that complete 2400 volt power systems cost $2.00 more per kva. than 4160 volt power systems.* In addition, it is assumed that an equal kva. of power system capacity (to that required for serving motors operating at primary voltage) is required to serve all other load which is operated at 600 volts or less. Thus, since the high voltage motors themselves require only one-half the system capacity, this means that two kva. per horsepower of high voltage motor must be installed. At $2.00 per kva. extra this would be the equivalent of $4.00 more per horse power of 2400 volt motors.

System costs are usually given in dollars per kva. but are plotted in Fig. 1 as dollars per horsepower, on the basis that the kva. and horsepower ratings of high-voltage motors are about equal.

By referring to the curves in Fig. 1, it can be seen that below about 175 hp., 440 volt motors are cheaper regardless of the primary system voltage. Hence all motors rated about 200 hp. or less should be operated on systems rated 600 volts or less, regardless of the primary voltage selected.

A close examination of the detailed prices will show that at 200 hp., the cost of 440 volt motors and starters with step-down substations (Fig. 2) is about equal to the cost of 2300 volt motors and starters (Fig. 3). This is the reason for placing the arbitrary division at 200 hp. rather than at 175 hp., as pointed out by the curve. These curves represent approximate prices and do not follow detailed variations. Hence, there is no justification for ever arbitrarily selecting 2400 volts as the primary voltage so far as any considerations of motors of 200 hp. and below are concerned.

From the foregoing it is seen that the choice between these two primary voltages is based on primary system costs and the cost of motors and control for those motors rated above 200 hp. Lower voltage motors (440 and 550 volts) need not be considered since there will be a transformation from either 2400 or 4160 volts to supply motors rated 200 hp. or less. As pointed out previously, and as shown in curves D and C, Fig. 1, the selection of a 4160 volt system and 4000 volt motors and control enables a less expensive over-all installation than the selection of a 2400 volt system and 2300 volt motors and control. In areas where the larger motors (i.e., those above 200 hp.) constitute more than about 50-60 percent of the total load, 2400 volts may be less expensive, providing the total load of the plant is not more than a few thousand kva.

In general, however, an equally satisfactory, yet lower cost power system can be obtained by selecting 4160 volts as the primary voltage for general power distribution.

Where 2400 Volts Is Particularly Applicable

Where 2400 volts is served directly from the utility system, then, of course, it would be more economical to use 2400 volts directly and to place all motors rated 200 hp. and above directly on the primary feeders. However, as in the case just discussed, nearly all motors rated 200 hp. and less should be operated on a 460 or 575 volt system, stepping down from a 2400 volt primary system. In some cases where there are existing 2400 volt systems in industrial plants, it is often more economical to extend these at 2400 volts rather than change to 4160 volts. However, it may be more desirable to extend it at some higher voltage, like 13.8 kv., rather than to extend the system at either 2400 or 4160 volts.

Twenty-four hundred volts is particularly applicable to concentrated loads of motors only which are rated 200 hp. and above, and where the primary supply voltage is above 5 kv. In these cases, it is preferable to step down from the higher voltage to 2400 volts rather than 4160 volts if the capacity per 2400 volt bus is limited to a few thousand kva., and nearly all of this load is utilized at this bus directly by the large motors.

A typical application where 2400 volts would be most economical is a pumping station, Fig. 5, in which the control may be of the fused contactor type or of the vertical-lift power circuit breaker type where the vertical-lift feature is desirable and where the frequency of starting is not too great. If this preference is followed, it will be necessary to make a transformation for these large motors. The cost of the transformation is substantially the same whether it is made to 2400 volts or to 4160 volts. Hence the power system cost is not a significant factor, since all of the load is concentrated in one place. The 2300 volt motors and their starters are less expensive than 4000 volt motors and their starters. This can be seen by comparing curves B and C., Fig. 1.

Where 2300 volt motor starters of 50,000 kva. interrupting rating can be used, some reduction can be obtained in the over-all cost of the 2400 volt installation compared with the lower voltage installation for motors below 200 hp. This merely reduces the crossing points of curves A and B, Fig. 1, to about 150 hp.

Even if plain motor starters without built-in short-circuit protection (and which are not generally recommended) are considered for both the 2300 and 4000 volt motors, there will be little change in the relationship of curves A and B, Fig. 2. These variables, together with the effect of explosion-proof requirements, have little bearing on the basic factors presented here.

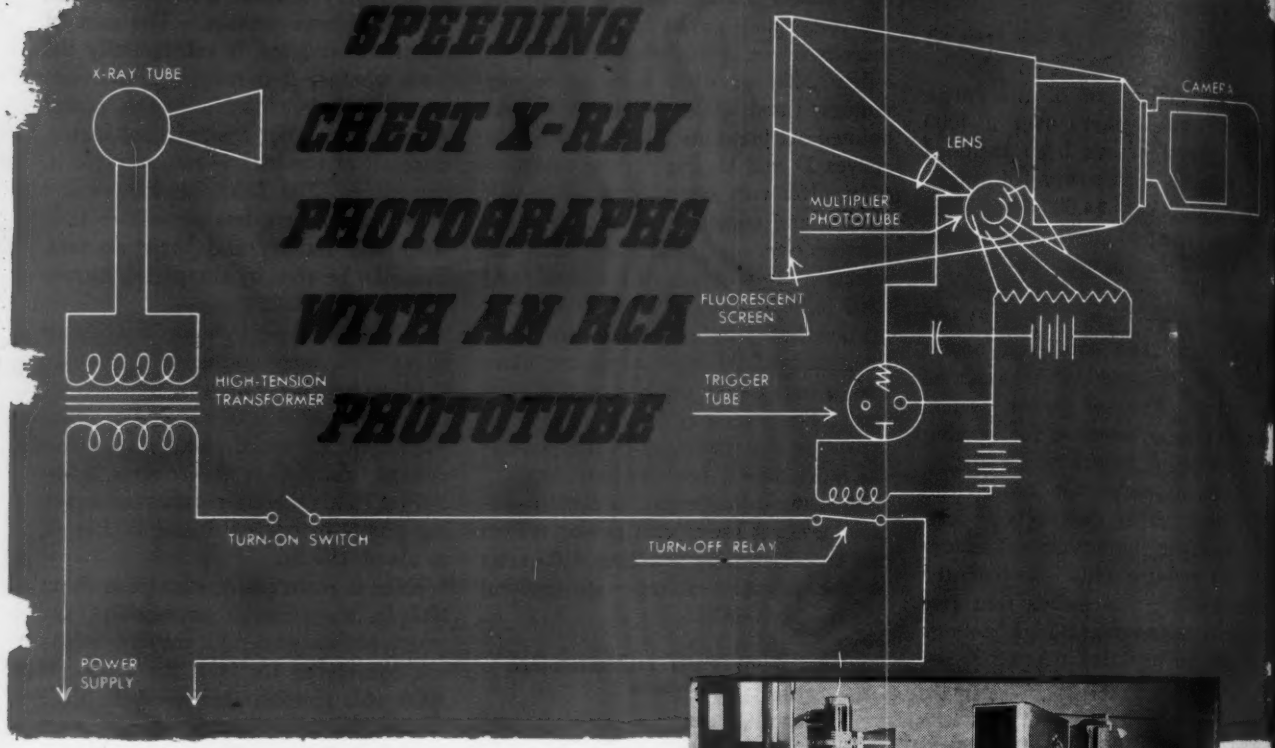
There is less price differential between low voltage (600 volts or less) and 2300 volt synchronous motors and control than there is between induction motors and control for these voltages. This differential will tend to make curve B cross curve A at about 150 hp. instead of 175 hp., as shown for induction motors, Fig. 1.

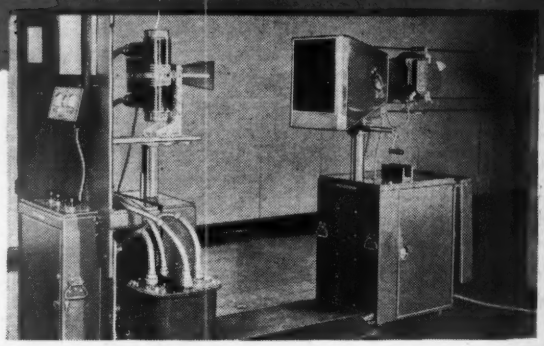
In many industrial plants, the great majority of the motors are rated less than 200 hp. and hence are operated from 460 or 575 volt distribution systems. In these plants there may be one or two motors which are considerably larger than 200 hp. In such a case it may be more economical, depending upon the size of the motor, to operate these larger motors directly from the 460 or 575 volt system. To provide a special transformer to step down to 2400 or 4160 volts (where the primary voltage is above 5 kv.) might be prohibitive in cost and should be given careful study.

Summing it all up, it is, in general, most economical to operate all motors rated 200 hp. and less on systems rated 600 volts or less, regardless of the primary voltage. Where a choice of primary voltage can be made, it is in most cases more economical to select 4160 volts rather than 2400 volts, even where the percentage of motors above 200 hp. is as high as 50 to 60 percent of the total plant load.

*This figure has been verified by many system studies made during the past few years. It is beyond the scope of this article to give the derivation of this figure.

SPEEDING CHEST X-RAY PHOTOGRAPHS WITH AN RCA PHOTOTUBE





Picker Minograph and Automatic Chest-Survey Unit uses RCA electron tubes to time X-ray exposures automatically

The Problem: A major bottleneck in chest X-raying technique was the measuring of the thickness of the body and guessing at density so as to get properly timed exposures. Each variation in body thickness or density required different settings of the controls. The quality of the picture was seldom uniform; the method was slow.

The Electronic Method: In the Picker X-ray unit, exposures are controlled automatically, the electronic way, from a single push-button; all body measurements and density determinations are eliminated. Excellent pictures result from each exposure with this new method, at a rate of more than 3 a minute.

How It Works: As X-rays pass through the body, they illuminate a fluorescent screen in direct proportion to the amount of X-radiation penetrating the body. The X-ray image is photographed on miniature film directly from the fluorescent screen. An RCA-1P21 phototube picks up light from the fluorescent screen. The amount of light necessary to operate the phototube is exactly the same as that required for a perfect photographic negative. Operation of the phototube triggers an RCA-1C21 gas triode, which trips a relay to shut off the power in the X-ray machine at the correct exposure interval.

Advantages: Speed, uniformity of exposure, and simplicity of adjustment for each new picture, are advantages for large X-ray clinics. Moreover, the machine makes it possible for any doctor, hospital technician, or other X-ray user, to take X-ray pictures of professional quality.

Other Applications of Phototubes: Phototubes, in conjunction with other RCA tubes, are performing innumerable automatic operations—such as counting, inspecting, sorting, measuring temperature, controlling lights, operating alarm systems, detecting fire and smoke, etc.

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For a helpful book of case histories, sen for a copy of "16 Examples of RCA Ele tron Tubes At Work in Industry." Write RCA, Commercial Engineering Depart ment, Section 62-61S, Harrison, Ne Jersey.

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ELECTRONICS

Maintaining and Servicing Sealed-Ignitron Rectifiers—III

By L. W. Morton
Industrial Engineering Division
General Electric Company
Schenectady, N. Y.

How to Care for the Tubes

Strictly speaking, there is not much that can be done in the way of preventive maintenance for sealed-ignitron tubes. There are, however, certain records which should be kept, and certain matters which should be well understood in connection with the handling of these tubes.

Tube Record Cards

Most tube manufacturers supply a tube record card with each tube. Whenever a tube is installed for regular operation, a detachable part of the tube record card should be filled in and mailed to the manufacturer of the tube for his record. The remainder of this card should be kept by the user, and when the tube has reached the end of its serviceable life, if the life has been less than the tube warranty period, the tube should be returned with the filled-in record card.

Tube Record Book

In addition to filling in the tube record card, it is advisable for the user to keep a tube record book. Most sealed-ignitrons have a life warranty. A typical such warranty is the so-called "36-60 month life warranty". The 36-60 monthly warranty means that the tube is guaranteed for 36 months' operating service, and, in addition, 24 months of shelf life. The latter provision is obviously to protect the user adequately from the standpoint of tube life for those tubes which he maintains as spares.

The purpose of keeping a tube record book is to record the performance of the tubes in sufficient detail so that the user can tell whether or not he is obtaining the expected tube life. Then, if the tube life is less than what should be expected, it is known, and the maintainer can look for the cause of the unsatisfactory performance, or call in the manufacturer's field representative for recommendations. Under such conditions, the record book helps the manufacturer's field engineers in analyzing the performance of the rectifier with the object of improving performance.

Arc-Back

Most rectifier users keep an operating log. In addition to the customary information usually contained in conventional operating log books, such as meter and instrument readings, maintenance records and daily notes, the log book should record any arc-backs, if they ever occur. Most sealed-ignitron rectifiers never have arc-backs. However, arc-back is a subject of importance to the maintenance man. An arc-back, of course, is an operating disturbance resulting from electronic failure of the tube. The tube fails to hold back the current during negative (part of the voltage wave); and this failure allows short circuit current to flow in the rectifier system. (See Fig. 5, showing paths of current during arc-back). This short-circuit current should be automatically interrupted by the power circuit breakers on both the a-c and d-c sides of the rectifier. After arc-back the breakers can usually be reclosed immediately and normal operation continued.

The time and effort required to keep a record of any arc-backs which may occur are justified if the frequency of arc-back becomes excessive. Acceptable arc-back frequency varies for

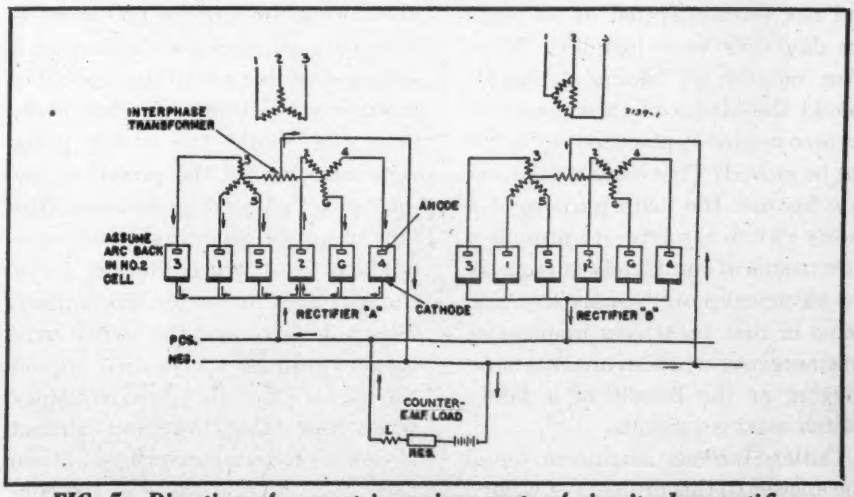


FIG. 5—Direction of current in various parts of circuit when rectifier A arcs back.

Important News for Every User of Electric Power

Now... A New Safety Switch that solves the long-standing problem of INTERNAL HEATING!



Safety switch users and designing engineers have long puzzled over a vexing problem of safety switch performance. All too often, perfectly good-appearing switches proved inoperative after a relatively short period of normal use. What made the problem a real mystery was the fact that many of these switches had been "used" . . . opened and closed . . . but a very few times. And some had not been operated at all since the day they were installed. Why, after months of "doing nothing", should the blades of these switches become welded in place so they could not be moved? This was a vital question because the main purpose of a safety switch is *safety*—to provide a sure means of completely cutting off the electrical power supply to a machine in that breathless moment of an emergency when an anxious hand tugging at the handle of a safety switch *must* get results.

Cutler-Hammer engineers found the answer to this problem of welded switch contacts, strangely enough, within the "nothing to do" life which all safety switches lead. They found that safety switches were far from idle during the months and months of seeming inactivity while they were simply standing guard for a possible emergency. During all this time, hour after hour, the switch parts were carrying *all* the power to the machines they were protecting. This flow of power generated much unavoidable heat which literally *baked* the life out of the switch mechanism. This baking caused the switch contacts to gradually relax their grip on the blades which they held so tightly when new. This lessening contact pressure produced sparking . . . then arcing . . . then *welding* of the contacts. Here, then, was the secret of most safety switch troubles. Internal heating, *time-welded* contacts! Today an entirely new line of Cutler-Hammer Safety Switches is ready to bring your men and equipment protection worthy of your insistence. Specify Cutler-Hammer and refuse any substitute. Carried in stock by recognized electrical wholesalers everywhere. CUTLER-HAMMER, Inc., 1306 St. Paul Avenue, Milwaukee 1, Wisconsin.

CUTLER-HAMMER
SAFETY SWITCHES
C-H

different applications, but in general anything exceeding more than two or three arc-backs for a single rectifier equipment per year should be investigated, and, if possible, corrected. Since the subject of arc-back reduction or elimination falls under the heading of trouble-hunting, it will not be covered in this part of this installment, but will be referred to later on under that heading.

Care of Spare Tubes

The sealed tubes are expendable and replaceable. It is recommended that the user carry one or more sealed tubes so that he can quickly replace any tube which has reached the end of its usable life, and thus avoid an unnecessarily long interruption. These spare tubes should be stored near the rectifier in a clean, dry place. Each tube should be kept in a vertical position so that all the liquid mercury remains in the bottom of the tube. This is important, because if liquid mercury becomes attached to the anode, it may arc-back when placed in service, whereas the arc-back would otherwise be unnecessary. A good suggestion for helping to keep mercury off the anodes of spare tubes is to keep the upper part of the tube, particularly the seal and anode lead, warmer than the lower part of the tube. This can be done by placing a lighted electric bulb near the upper part of the tube. The heat from the lighted lamp will be conducted by the anode lead to the anode inside the tube. If the anode is kept warmer than the mercury at the bottom of the tube, it tends to keep mercury from condensing on the anode.

It is good practice to test the spare tubes at intervals of six months to make sure that they are always ready for instant operation. The best test is to actually operate the spare tube in the rectifier unit.

Many users follow the practice of rotating spare tubes with operating tubes every six months. There is no objection to this practice and it does not invalidate the warranty of the tube. In other words, the 36-month operating warranty is based on the time the tube is installed in the equipment. When tubes are taken off the shelf and installed in service, they can be removed from the equipment later before the end of the 36-month operating period and placed back on the shelf, and later returned to service. The period while the tubes were back on the shelf is not considered part of the 36-month operating warranty, but, of course, it must be considered part of the two-year shelf warranty.

It is advisable to test the operation of the ignitors occasionally, using the oscillographic method to determine whether the ignitors are firing easily or hard, or are perchance occasionally misfiring. For most rectifier installations, a small amount of ignitor misfire does not cause any harm or inconvenience, but experience has indicated that if an ignitor misfires more often than five to 15 times per minute, there is usually something wrong with it, and it will get worse very soon. On that basis, such ignitors should be retired from service. A complete description of how to make ignitor tests will be given in Part IV of this article, under "Trouble Hunting."

Sealed ignitron tubes for rectifier service are usually equipped with one or more spare ignitors. The spare ignitor is intended to permit operation to continue in case of mishap, such as reverse voltage burning off the tip, to the ignitor initially placed in service. If misfire develops and is not corrected by connection of the spare ignitor, the volt ampere firing characteristics may be checked to determine whether the difficulty is in the ignitors or the excitation circuit.

There are three ways of quickly telling whether misfire is present, during the daily inspection of the rectifier unit:

1. *Sound of the Transformer*—Rectifier transformers have two fundamental frequency notes present when there are interphase transformers used. The first is the deep note of the supply frequency, usually 60 cycles. The second is a multiple of the supply frequency which in the case of 6-phase, double-wye connections is usually three times 60 cycles, or 180 cycles. This gives a shrill high pitched overtone. When everything is normal there is the steady sound of these two combined notes produced by the transformer. The level may be modified by the amount of rectifier load or by the amount of grid control. However, if misfire is present it causes a distinct snapping or knocking sound which is readily distinguishable from the regular hum of the transformer. Therefore, if appreciable ignitor misfire is present it can usually be easily detected by listening to the transformer.
2. *Glow inside the tube*—Another way to check for ignitor misfire is to look for the absence of glow in the tubes when there is load on the rectifier. In some tubes the characteristic blue mercury vapor glow may be seen through the glass anode seal. The glow can be seen more positively, however, through the glass ignitor seals at the bottom of the tube. Inspection for glow through these ignitor seals may be facilitated by using a small mirror on the end of an insulated handle. The tubes are electrically hot while under load. Hence the insulated handle. If misfire is present, there will be periods when the glass seals are black. Otherwise, these seals have the characteristic color of the mercury arc.
3. *Action of the Ignition Checking Relays*—An induction disk type relay having adjustable time lever setting is usually connected in the control circuit to detect misfire. If misfire persists for a definite time, the relay rings an alarm. When either of the above two

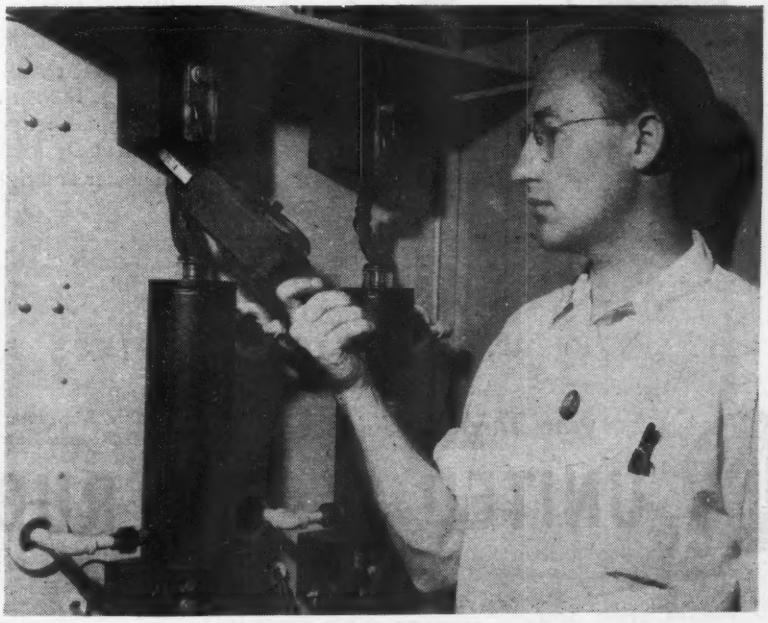


FIG. 5-A—Measuring individual tube current with hook-on type ammeter.



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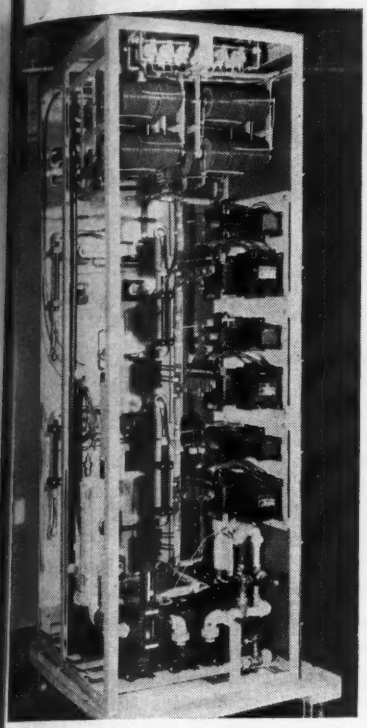


FIG. 6—Rear view of sealed ignitron panel, with cover plates removed. Shown are the firing circuit components assembled and wired at upper and right-hand side, cathode current connections, and part of water cooling system at left.

checks indicate possibility of misfire, it can be confirmed by watching the disk of this relay through the transparent relay cover. The relay is so connected in the control system that ignitor misfires start to turn the disk. If inspection shows the disk is tending to turn and then return to reset position, it indicates that some tube is misfiring. Further details of the Ignition checking circuit, and what to do in case of misfire are included under "Trouble Hunting" in Part IV of this article.

Tube Current Balance

It was pointed out in the inspection chart that the performance of the tubes in respect to their sharing of the total rectifier load current should be watched, both daily and monthly. In general, the current through the tubes should be equal within plus or minus 10-15 percent for loads above one-half of full load rating.

For a quick check there are two methods. The first is to inspect the intensity of the arc glow as described in the previous paragraph. Complete absence of glow or significant differences in the intensity should be followed up to determine what is the cause. The second method is to measure the anode seal or lead temperature by thermometer. If the tube currents are balanced these temperatures should be equal. Severe unbalance may be detected by noting the difference in radiated heat from these tube parts, placing the back of the hand near but of course not on the seal.

(Note: The voltage of the anode is the so-called "peak inverse voltage." For single way rectifier circuits this is usually slightly over twice the d-c output voltage. Therefore, when working around these tubes while they are electrically hot, suitable precautions should be observed.)

If an accurate test of tube current balance is desired, the hook-on ammeter method is recommended (Fig. 5-A). A type using a split core transformer with its secondary connected to a rectifier instrument through a range selecting switch is desirable. The easiest place to measure the current is on the anode lead, but the instrument should have a well-insulated handle and the testing should be conducted carefully because of the before mentioned anode voltage. These hook-on ammeters do not read accurately either the average or rms anode currents, because of the unusual wave shape of rectifier currents. They do, however, provide a means of determining percent unbalance from tabulated anode currents if the readings are all taken at any given rectifier load.

Procedure for remedying tube current unbalance if it is observed during the regular inspection period will be given under "Trouble Hunting", Part IV of this article.

Pink-Blue Tube Arc Color

In case the color of the arc, as observed during inspection, has a pinkish tinge instead of the normal blue mercury arc color, it indicates that the tube is leaky. Whenever such a tube is found further tests for vacuum tightness, which will be described under "Trouble Hunting", Part IV, should be conducted.

Tube Operating Temperature

The range of acceptable operating temperature (water jacket temperature) of sealed-ignitron tubes is wide (5–50°C). However, these limits may not be greatly exceeded before maloperation (usually arc-back) results. During the daily inspection, it is therefore possible to tell quickly whether the temperature is within reasonable limits by feeling of the tube jackets, while standing on an insulating platform or rubber mat to protect the person from electrical shock.

The average operating tube temperature may well be tested by thermometer occasionally to make sure the automatic valve, thermostatic relay, or motor driven blower is adjusted to hold the desired tube temperatures. Rectifier units having Type 1 (a) cooling will have tubes operating at various increasing values between the incoming water temperature and the temperature setting of the automatic water valve. While it is permissable for this to be as much as 45 degrees C (50°C out minus 5°C in), it is desirable to narrow the temperature rise of the water through the tubes down as much as possible without running the water rate up too much. Lowering the setting of the automatic water valve accomplishes this objective.

The other cooling methods all employ recirculating water pumps, and usually parallel the flow of water through the

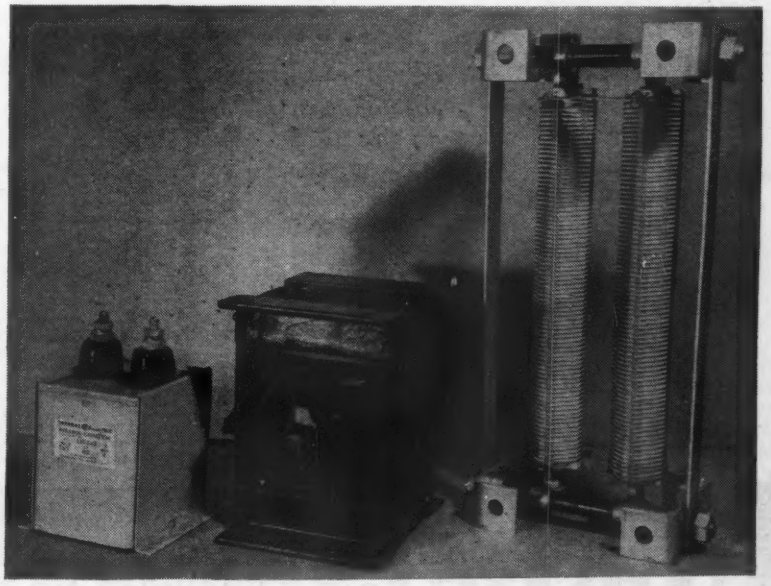
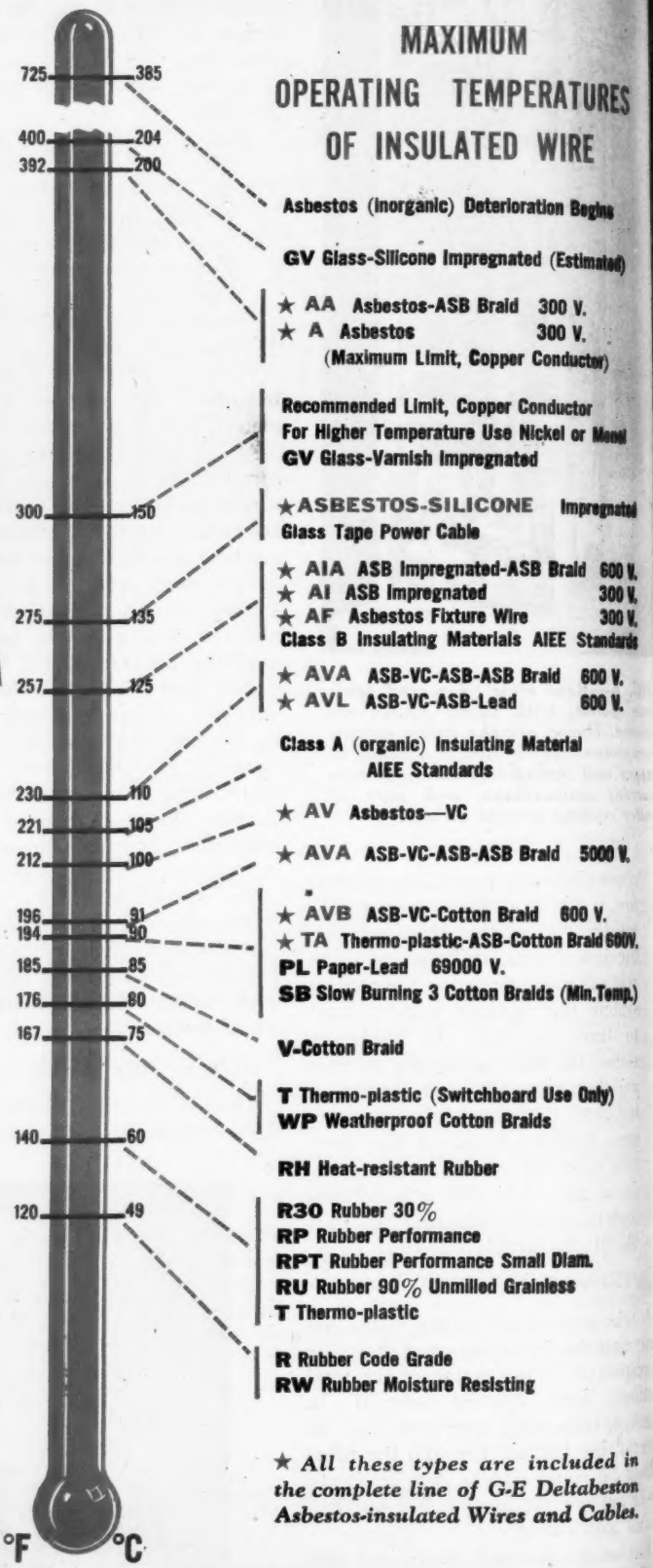


FIG. 7—Component parts of static magnetic ignitron firing circuit. Left, capacitor; center, saturable reactor; right, wire-wound resistor.

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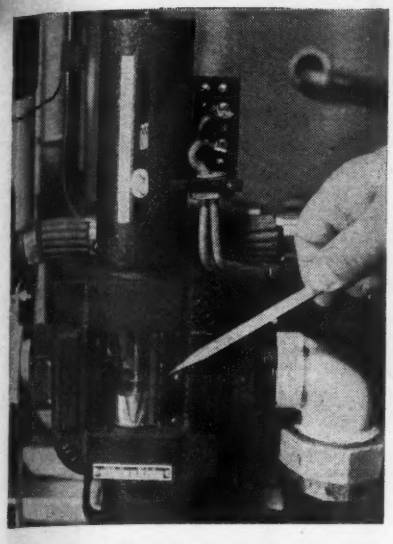


FIG. 8—Water-flow relay. Pencil points to sight gage glass where quantity of cooling water passing through rectifier can be checked visually. Scale reads in gallons per minute. The electrical contacts of the relay may be set to operate at different rates of water flow by loosening the two screws and adjusting the position of the pointer on the upper part of the relay.

tubes. This permits all tubes to operate at approximately the same temperature. It is advisable to test the individual tube temperatures of all tubes while the rectifier is under load at least annually where recirculation is employed. If there is a difference in any of the tube temperatures, it may mean unequal water flow through the tubes caused by accumulations in the water piping or cooling passages of some of the tubes. Such tubes then may run too hot and cause arc-back, or shorten the tube life. However, these obstructions to free water flow should be removed.

Unless the water rate becomes unacceptably excessive, it is best to keep the maximum tube operating temperature lower than 50° (35–40° C is an ideal operating temperature for sealed ignitrons).

The water temperature of the tube controls the mercury vapor pressure inside. Water in the cooling jackets also removes the losses from the graphite anode. These losses are radiated from the graphite through the vacuum to the water cooled surface inside the tube. For this reason the anode heats to a high temperature, and becomes cherry to red hot above one-half to three-quarters load. The red hot anode may be seen by looking through the anode glass seal. It is a perfectly normal operating condition.

This high anode temperature causes high anode seal and lead temperature, when substantial load is carried by the tube. Temperatures up to 250° C are acceptable. It is important, however, to prevent water from splashing, spraying, leaking, or dripping on these glass anode seals since it will cause them to shatter instantly when they are such high temperature.

Thyratron Firing Tubes

In case thyratron tubes are used in the ignitor firing circuit they deserve some attention during inspection. First they should be examined for color; a pinkish blue in the glass grid seal indicates a leaky tube. If any sparkling particles can be seen flying around inside the tube it indicates low cathode emission. Low cathode emission may also cause ignitor misfire which is not explainable by any other reason. If the tube has no arc color or is stone cold, it indicates a burned out filament. Any of these symtoms call for a replacement tube. Most thyratron firing tubes should give 18 months or more tube life. Usually such firing tubes have protecting fuses and serious firing tube trouble usually causes burning of the associated fuse.

How to Care for the Excitation Equipment

There is little to do in connection with maintenance of the ignitor excitation equipment. For purposes of this discussion it is assumed that a magnetic excitation system of the type illustrated in Figs. 6 and 7 is supplied with the rectifier unit. Such a system consists of small, dry-type transformers, linear reactors, saturating and saturable reactors, capacitors, dry plate rectifiers, and resistors so combined that they generate peaked positive voltages for the ignitors, holding voltage for the holding anodes, and also, provide a means for phase controlling the rectifier output voltage.

The principal maintenance work is to keep them clean of dust or dirt so that they remain cool. It is also important to keep them dry, since moisture may cause insulation failure.

Regular monthly inspection should include an examination of the various dry-type transformers and reactors to see if they are running too hot under load conditions. Most of these devices have Class B type insulation so that temperatures up to about 110° F are permissible. The capacitors should be inspected for oil leaks and their temperatures should not exceed 40° C rise over ambient. If any of the devices are too hot they should be replaced or else the recommendations of the manufacturer's field engineer obtained.

Dry Plate Rectifiers

The dry plate rectifiers should have a very careful annual checking. This should include testing their operating temperature by thermometer. Selenium stacks should not exceed a maximum of 70° C, final temperature. Oscillograph tests should be made, looking for the presence of inverse current in the ignitor. The method of making this test will be described in Part IV of this article. This is an advisable test as it indicates if there are defective stacks in the dry plate rectifier. Such defective rectifiers may cause the ignitors to burn off if allowed to continue in operation.

Visual examination of the stacks should include looking for two kinds of defects. The first defect is evidence of past overheating. On selenium disks this is indicated by a slumping, or bead of solder, on the under side of the disk. The second type of defect takes the form of burned spots on the disks. These will be small, rough, brownish blemishes at the junction of the pressure washers and the silvered selenium coatings of the rectifier disks. Such spots represent places where the selenium has shorted through and which may or may not have been burned open.

In some cases the individual disks may be tested with multimeter type ohmmeters. Each disk should be tested for d-c resistance in one direction and then repeated in the opposite direction. Two values of resistance for each disk should be obtained if the disks are normal and healthy, one many times higher than the other.

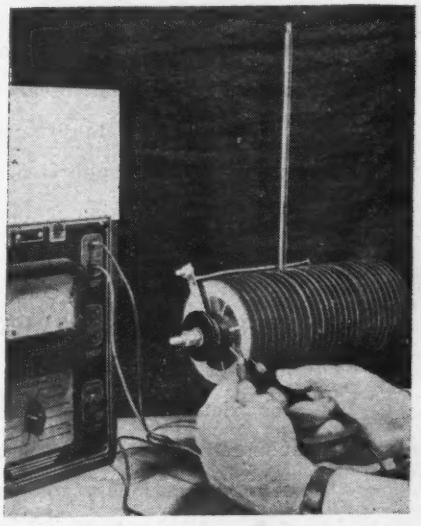


FIG. 9—Testing dry-plate rectifier stack from ignitron firing circuit. Operating temperature is measured by inserting thermometer or thermocouple between disks, using putty. Putty should be cleaned out before it hardens. Defective disks are found by measuring the resistance of each disk separately with a d-c ohmmeter. Make two tests for each disk, reversing the polarity. Good disks will measure nearly infinite resistance in one direction and less than 100 ohms in the opposite direction.

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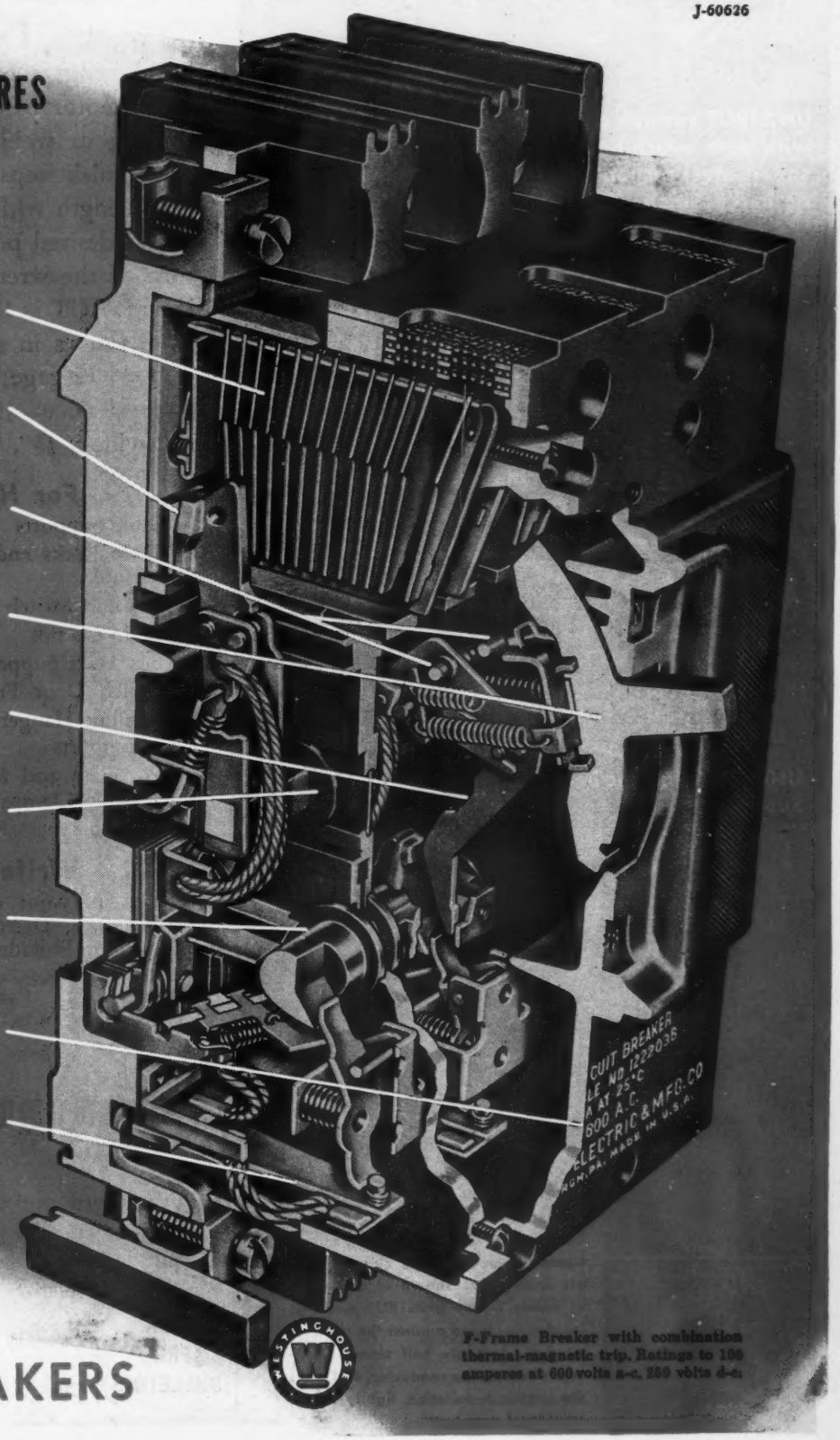
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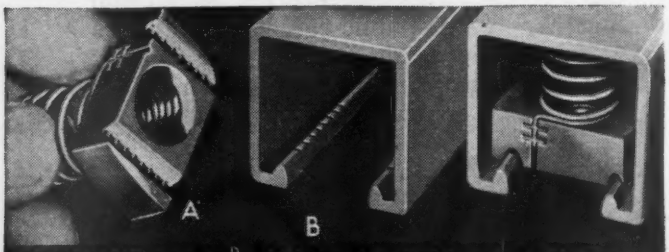
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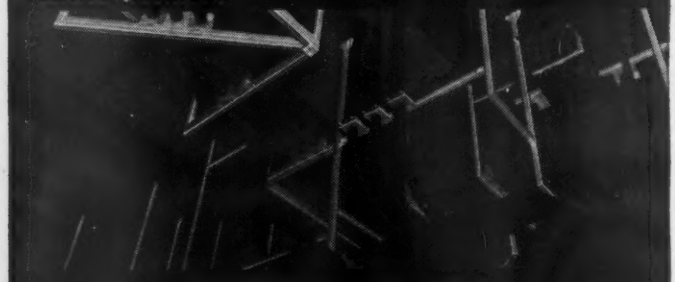
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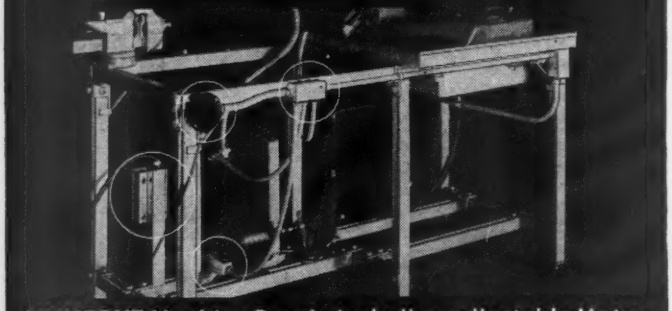
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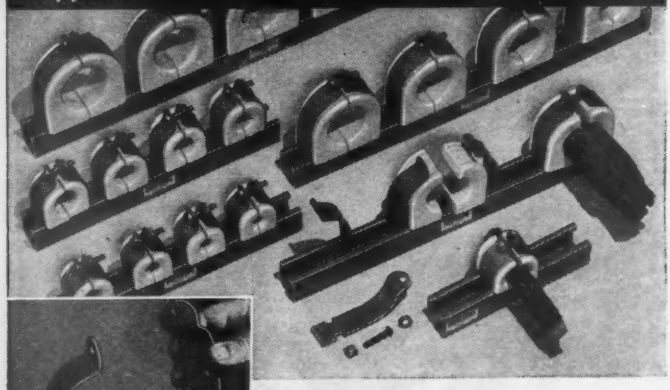
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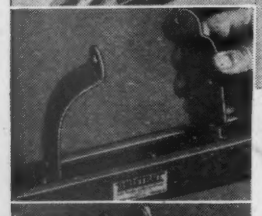


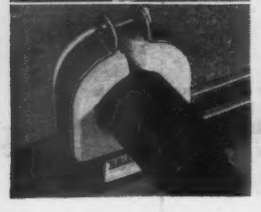
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[FROM PAGE 69]

ure of the motor and the surrounding test box until all the original air has been displaced. The inlet and outlet connections to the carburetor system are then closed, and the mixture is ignited within the motor casing. The appearance of flame or dangerous sparks or the explosion of the surrounding vapor-air mixture indicates failure of the device (Fig. 9). If the results of the first test are acceptable (the explosion does not propagate outside the motor), the products of combustion are removed with a stream of compressed air and the explosion test series is continued with different vapor-air mixtures representing each one of the zones of mixture likely to cause failure. In each test the maximum internal explosion pressure is determined. The investigation of Class I motors includes tests conducted with the motor idle and also with the motor running.

In the tests of explosion-proof devices intended for interrupting current, such as switches and circuit breakers, a series of explosion tests are conducted in which the arc resulting from interruption of specified electrical overloads is used to ignite the explosive vapor-air mixture in the enclosing case. *Electrical failure sometimes results in these tests although the equipment previously withstood similar electrical loads without the presence of the flame from the exploding vapor-air mixture.* This is possibly due to the electrically conducting properties of flame, which shows the phenomenon of ionization.

Gas or vapor-air mixtures are capable of being ignited by contact with heated surfaces having a sufficiently high temperature, referred to as the "ignition temperature." It is necessary, therefore, to determine that the maximum temperature under operating conditions of equipment for use in Class I hazardous locations is safely below the ignition temperature of gases and vapors included in the group in question.

Research tests conducted at Underwriters' Laboratories have developed data as to the autogenous ignition temperature of many gases and vapors. This temperature varies widely, for example: 280° C (563° F) for gasoline; 180° C (356° F) for ethyl ether; 100°-106° C (212°-223° F) for carbon disulphide and 371°-427° C (700°-800° F) for ethyl alcohol.

Tests of Dust-Tight Equipment

The testing of equipment for use in Class II hazardous locations presents a somewhat different problem because, as previously explained, *apparatus for use in dusty locations is designed to be dust-tight. It is not intended to resist internal explosions of dust-air mixtures.* Obviously, if the dust is excluded, there will be no dust-air mixtures within the enclosure to become ignited. Accordingly, equipments for use in Class II hazardous locations are tested in specific dust-air mixtures in order to determine that the enclosures are dust-tight, and that overheating does not occur when the device is blanketed with dust.

A test chamber with auxiliary dust-circulating equipment was designed and built at Underwriters' Laboratories for the tests of Class II motors, industrial control equipments, switches, lighting fixtures, etc. By means of this apparatus (Fig. 10) a dust-air mixture is projected through nozzles against the joints, shaft clearances, and other openings in the enclosure of the device under investigation. *Intermittent operation tests are conducted to determine if pressure changes during heating and cooling cycles will cause dust to enter the enclosure.* Blanketing tests allow layers of dust to accumulate on the device, while it is being operated at rated electrical load to determine the operating temperature. At the conclusion of the investigation the dust is examined for evidence of ignition or charring. The device is then disassembled and the inside of the enclosure is examined for the presence of dust.

Wartime expansion in the use of magnesium and aluminum and their alloys has increased the number of plants in which grinding or machine operations on these metals may produce hazardous dust-air mixtures. Motors and some other types of electrical equipment have been tested in the presence of magnesium dust-air atmospheres as described above. *These equipments are now listed for use in Class II, Group E.*

As yet, no electrical equipment has been tested or listed for use where dusts of military explosives are present. It is preferable, wherever practicable, to locate electrical equipment outside of areas where such dusts may be present. In no case should electrical equipment be installed in locations where it is impracticable to prevent accumulations of dusts of these explosives. Cleanliness and good housekeeping are absolutely necessary.

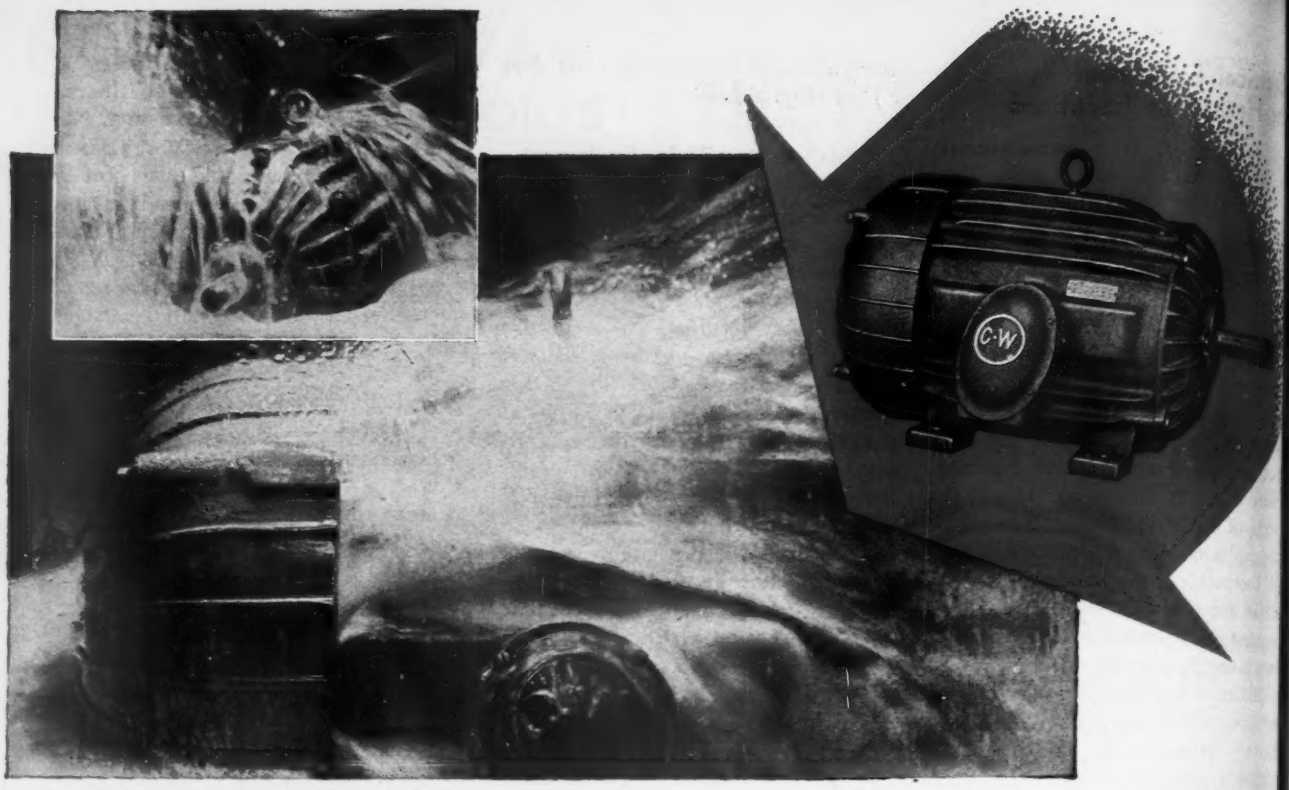
The safe use of electrical equipment in atmospheres containing dusts of military explosives will depend largely upon proper maintenance and prevention of overheating, which may be caused by accumulation of dirt or dust or by overloading and stalling. Proper selection and maintenance of the overload and short-circuit protection is essential to avoid overheating. All such electrical equipment should be of the hazardous-location, dust-tight type, Class II, Group E, with relatively smooth exteriors of shapes easy to keep free from dust accumulations. Class I, Group D explosion-proof equipment, if provided with the same dust-tight features as Class II, Group E, may be acceptable.

The use of Class II, Group E equipment is not limited to atmospheres of metal dust. It is effective in preventing entrance of more penetrating dust than is encountered in Groups F and G location. Group F and Group G equipment was used in atmospheres of dusts of explosives before Group E equipment was available.

Electrical equipment which has been tested by Underwriters' Laboratories and found to meet the rigid test requirements for safe use in hazardous locations is listed in Section II of the "List of Inspected Electrical Equipment." Electric motors, enclosed switches, circuit breakers, and panelboards can be recognized in the field by the Underwriters' Laboratories label which appears on the device.



Here's the answer, says Gordon Larsen, (center), operating supervisor of the Wisconsin-Michigan Power Co., Appleton Wis., as he seeks an interpretation in the new Wisconsin State Electrical Code for electrical inspectors P. C. Killian of Kaukauna, and Louis Luebke of Appleton, Wis.



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Answers had to be found to these questions before the motor could be offered to industry as an *improvement* over existing fan-cooled designs. So two brutal tests were devised:

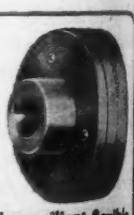
In performing the first test a standard **SEALEDPOWER** motor was placed in a tank containing six inches of water, and run for eight hours without stopping; it was then shut down and the operation repeated the following day. All during the operating period the ventilating fan of the motor continued to throw water over the frame, shields, bearing housings, shaft and junction box (see illustrations), thoroughly drenching the entire exterior of the motor and yet, at the end of the test, the motor was taken apart—and the inside was found to be "bone" dry! Excessive moisture will offer no problem to this motor.

In the second test, a dense atmosphere of French chalk was kept whirling around the motor by means of fans. But, at the conclusion of this test, not a trace of chalk was found on the windings or elsewhere within the motor—conclusive proof that the **SEALEDPOWER** motor is truly dust tight.

An exclusive Crocker-Wheeler design, the **SEALEDPOWER** motor is suitable for applications where you have been using conventional fan-cooled motors. Why not try one of these motors—in an unusually damp or dusty location?

Send for full information. Please write on your company letterhead—no obligation.

THIS COUPLING IS UNIQUE, TOO



The Crocker-Wheeler resilient flexible coupling consists of a spider, a flange, a ball retaining cover and six synthetic rubber balls—that's all there is to it! And yet, this is more than just a trouble-free coupling—it actually adds years to the life of both the driving and driven machines.

The balls transmit torque, absorb shock and vibration, yet do not transmit end thrust. Available for shaft diameters up to 8", these couplings require no lubrication, no maintenance of any kind. Write for complete information.

CW-7

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SQUIRREL CAGE MOTORS WOUND ROTOR MOTORS DIRECT CURRENT MOTORS GENERATORS FLEXIBLE COUPLINGS

MOTOR SHOPS

COIL INSULATION BOILED AND SCRAPED

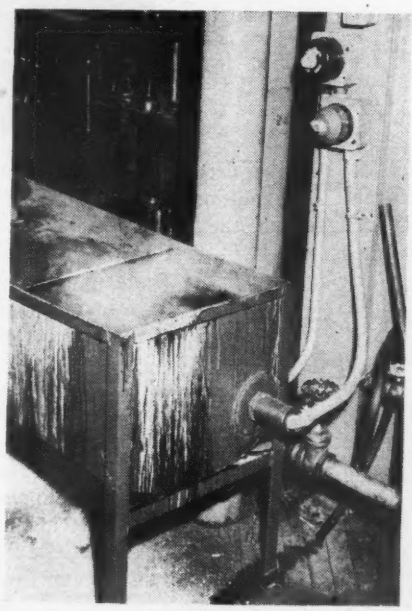
It is common practice to reuse the undamaged copper in bar and strap coils when rewinding wound rotors, armatures and stators. Removal of the old insulation frequently presents a production problem. Unless the impregnating varnish is softened, the insulating covering will not come off. When burning off this insulation, there is always the danger of warping the copper with the added chore of reshaping the coil.

In view of these difficulties, Spaulding Electric Company, one of Detroit's largest electric motor repair shops, experimented with the idea of "boiling out" the impregnating varnish and then scraping the copper. To do this a No. 12 gage sheet steel tank, supported on an angle iron frame, was constructed. Measuring 30-in. long, 18-in. wide, and 15-in. deep, it holds from 30 to 35 gallons of mild alkali solution (½-lb. of "Metso 99" powder to 30 gallons of water). A sheet steel cover fits over the top of the tank when the boiling takes place.

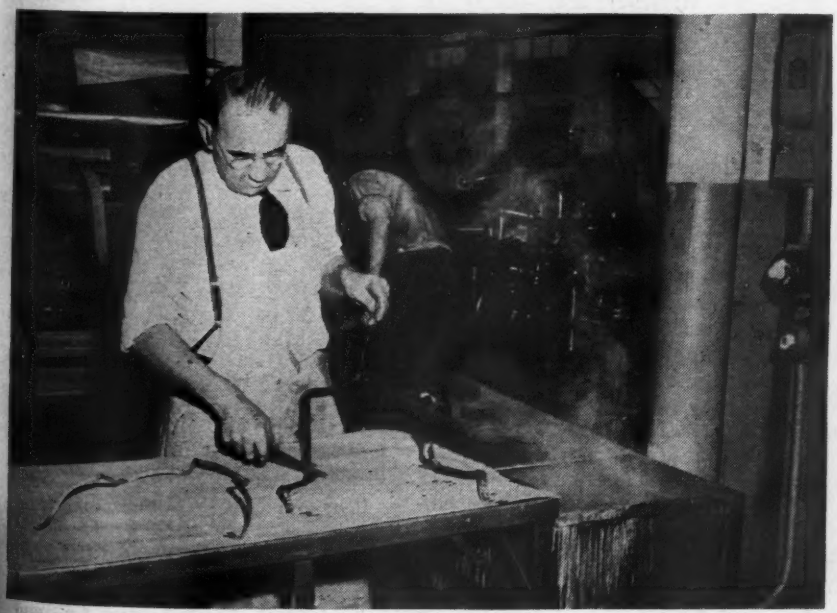
To heat the solution, the tank is equipped with two, 10-kw. Calrod electric immersion heating units—one in each end of the tank near the bottom. Each heater, equipped with suitable taps, is connected to a 220-volt, single-phase line through a 3-heat rotary switch (high, medium, low, off). With this flexibility of control, portions or all of one or both units can be used to heat the solution.

The old coils are placed into the cold solution. At high heat with both units (normally used) on, the coils can be brought to a boil in approximately 90 minutes. They are kept in the boiling solution for about 3 hours to permit complete dissolution of the organic varnishes impregnated in the coil insulation. After the coils are removed from the boiling solution, it is a simple matter to scrape off the softened insulation and emerge with a perfectly clean copper coil.

Estimates of labor economies range from 15 to 20 hours per rewind job—taking into consideration the burning off and straightening that was necessary under the old method. Not only is a cleaner job accomplished, but the repaired motor can be returned to the user in a much shorter time.



Three-heat control of electric heating units in the tank. Other unit is at opposite end of tank.



Scraping insulation off of old strap copper coils after 3-hour boiling in alkali solution. Boiling dissolves organic varnish impregnation. Result: 15 to 20 hours per rewind job is saved.

FROM CREAM SEPARATOR TO COIL WINDER

By JAMES CLYDE PORTER

J. Leon Moore, owner of Leon's Electric Service Shop, Great Bend, Kansas, had a couple of old DeLaval cream separators kicking around the shop. Being a person of considerable imagination and ingenuity, he held on to them knowing that some day he could put them to some useful task.

Now, Moore was in dire need of a motorized coil winder. Winding coils by hand was a tough proposition. A few more glances at the obsolete cream separators and the picture of a winding machine began to take form in his mind. That plus some odds and ends of equipment was all that was needed. Adding a dash of ingenuity and a good bit of mechanical and muscular effort, he emerged with a first-class winder that has been giving him excellent service. Here's what he did.

He took a ¼ hp., burned-out, repulsion-induction motor and rewound it by hand. Mounting this in a wooden enclosure to house the winder, he added the drive and worm gears from one of the cream separators to connect the motor to the winding head shaft. With this arrangement he could secure winding head shaft speeds of 17, 34 and 69 rpm.

For a base to the winding head enclosure, he welded together, end-to-end, the pedestals of the two separators (one inverted). A foot pedal operates the unit, leaving both hands free to



YES, like thousands of others throughout the industrial world today, we have used our experience, skill and research to help achieve the long awaited and inevitable goal . . . complete victory!

However, we don't intend to let these hard-earned advantages lie idle now that the war is won. Ours is the desire to share them with you, so that they may be used to "iron out" the many difficult and widely diversified problems encountered with the application of insulating varnishes and compounds in today's production cycles.

We can help you in your post-war program. Take advantage of our 35 years' experience in the insulating varnish field, and join the ranks of "the many satisfied users of DOLPH'S Products."

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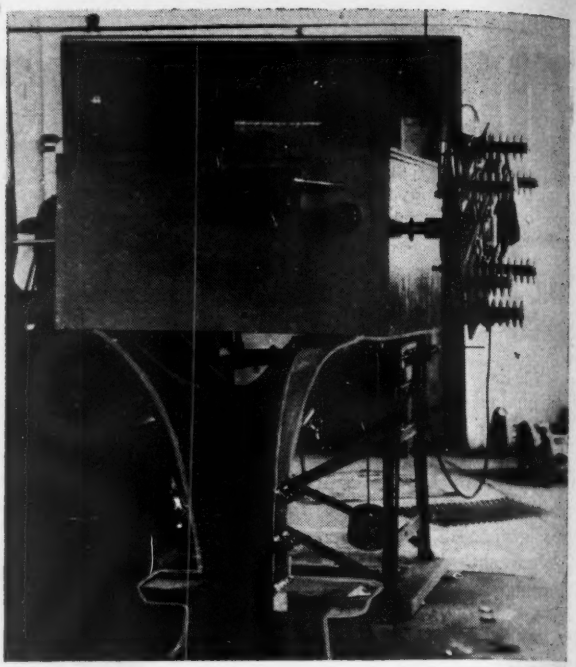
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Home made coil winder — the result of imagination, ingenuity, an old motor, a couple of old cream separators and some real mechanical ability.

guide the magnet wire on the coil forms. A revolution counter, mounted to the top of the enclosure, is connected to the winding head shaft by a speedometer coil salvaged from an old automobile speedometer (a hole drilled in the end of the drive shaft provides the connection point).

Three different winding heads are used—two for winding coils for motors from fractionals up to 50 hp. in size; the third for mounting coil forms when necessary. The heads are equipped with adjustable spools for various sized coils and also with a release lever to facilitate quick and easy removal of the wound coil.

Although the cream separators are now a dismembered mass of scrap, Moore has a piece of equipment that boosts the efficiency and quality of workmanship in his shop.

PORTABLE TEST PLATFORM

In testing small motors or generators, up to 30 h.p., Kuchel & Sievers, San Francisco, use a portable test set mounted on casters to go any place in the shop to pick up the machine to be tested. It was designed by mechanic L. H. Collarino.

A generator is mounted permanently on one end of the wood beam structure which forms the base. At the other end of this structure are mounted two hollow steel members, longitudinally, one on each side, forming rails. They are slotted lengthwise.

On top of them rest two cross members of channel iron at right angles to the rails. These may be moved along the slots to any position desired and then fastened by bolts up through the ends of the cross members and the slots in the rails. The heads of the bolts seat on the underside of the slots and nuts are then drawn down on top to lock the cross members in place. These cross members then form the base for the machine to be tested, positioned to get the right tension in the belt between the two machines.

This is a quicker and more stable set-up than to have the generator fixed to the floor and then bringing up the machine to be tested and attempting to block or otherwise fix it in position.

If the machine to be tested is a generator, the regular generator mounted on the base is operated as a motor and turns the generator to be tested by the belt. Routine tests are thus performed, it being in the mounting that the novelty lies.



Pros and cons of cabinet concentric knockouts are aired by (L to R) James Smith, Chicago district manager and Edwin Landmeier, vice president and chief engineer of Wadsworth Electric Mfg. Co., and electrical inspector Edwin Klitzke, Oshkosh, Wis., at recent conference of the Wisconsin Chapter, IAEI.

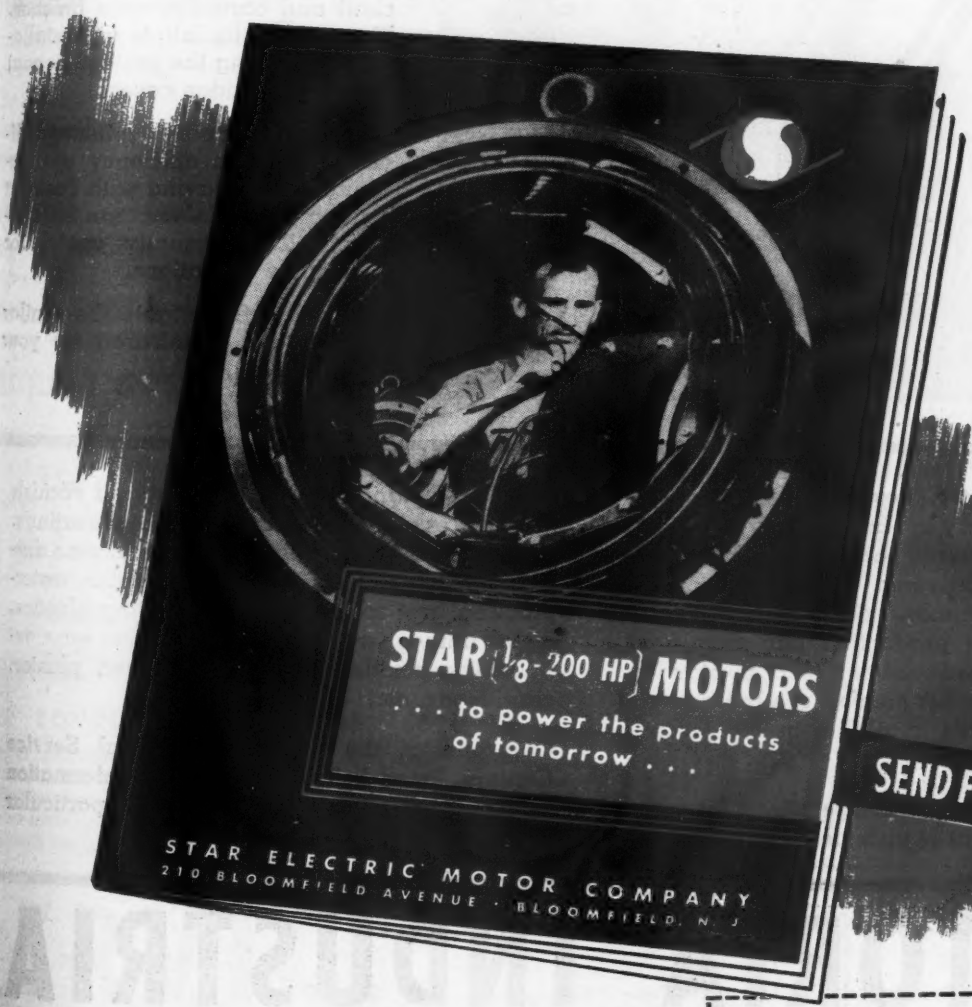
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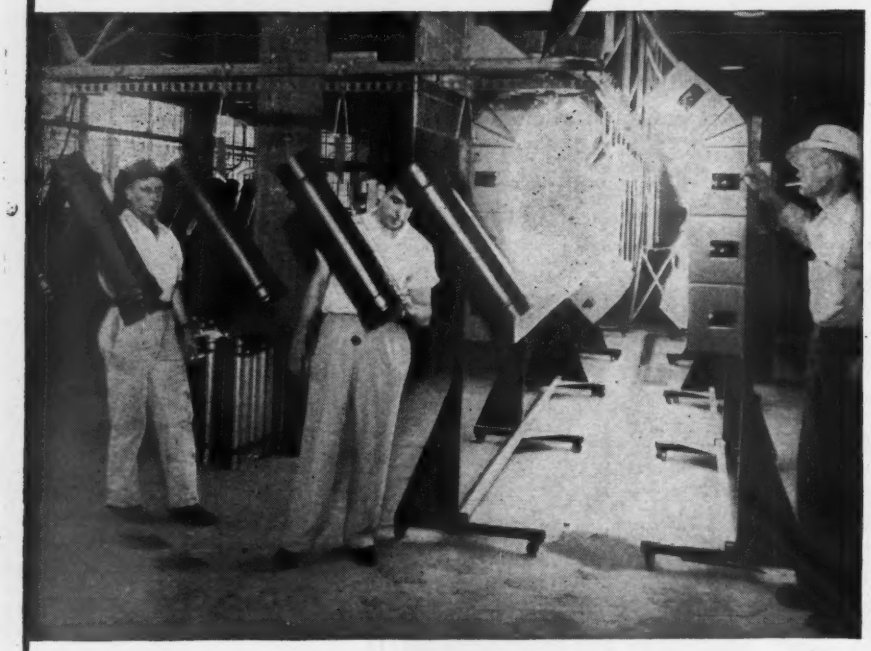
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A Typical Installation
SHELL CASE FINISH BAKED IN 9 MINUTES

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Baking time of only 9 minutes indicates the high efficiency production and cost saving with Fostoria equipment. This wartime installation will be equally useful for peacetime operations.

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Throughout industry, new high standards of production efficiency are being set by the utilization of Infrared Energy for baking, drying, dehydrating and preheating. Cost savings of 50% and more are common. Such advantages as *greatly increased production per man hour, less floor space needs, fewer rejects, no stand-by loss, and more worker comfort* are but a few of the proven benefits available in the Fostoria Evenray System.

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HIGHEST RADIATION EFFICIENCY
Fostoria Evenray equipment, utilizing technically designed gold plated reflectors and clear glass Infrared lamps, is superior to any other equipment in useful radiation efficiency. Actual tests prove 20% higher efficiency as compared to reflector type lamps alone.

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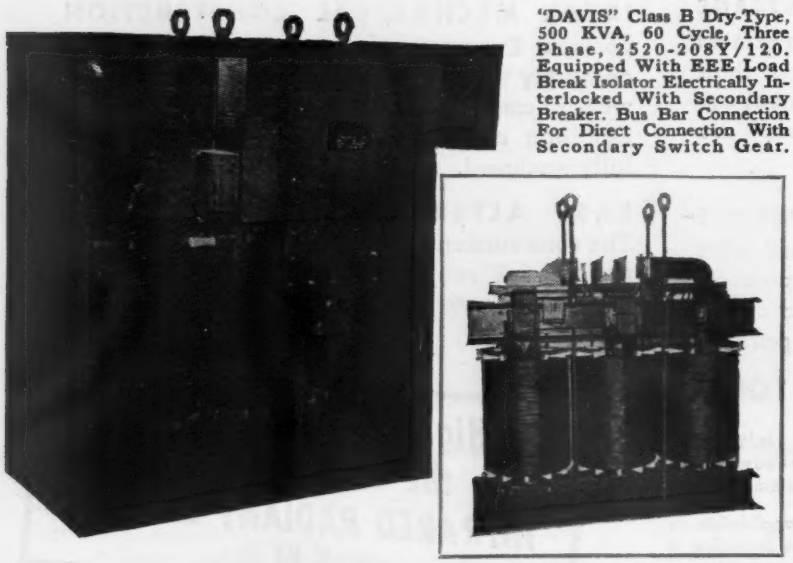
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SHOW WINDOW LIGHTING TECHNIQUES

[FROM PAGE ...]

proximately the mounting height of the reflectors, wide angle type fluorescent units, properly shielded with louvers (Fig. 8-C) are satisfactory for use.

Reflector spot lamps and reflector flood lamps may be used to light shallow and medium depth windows. Care should be exercised to shield such units from view of window shoppers, using available type louvers, or special construction designed to conceal the equipment.

Color, intelligently applied, enhances show window displays and adds interest to the display. It can be used to highlight features of the display. It may also be used to provide background effect for feature displays which are highlighted with white light.

One trend in new store design is to use all glass fronts, so that the entire interior of the store becomes a display area as viewed from the street. Spot lights concealed above the ceiling on adjustable swivels provide a means of highlighting feature floor displays within the store. Flush recessed glass lens units, or recessed and louvered reflector units, located in the ceiling close to the plate glass, provide accent lighting for low displays.

The techniques discussed herein provide high intensity lighting and flexibility in effects efficiently and economically. For certain type show windows, other techniques have advantages. For example, in windows where furniture is displayed, diffusing glass ceilings uniformly lighted from above are effective in providing uniform diffuse light on the display from front to back. This permits furniture to be seen easily in normal settings with a minimum of reflections from bright light sources in polished surfaces. Lighted portable floor and table lamps also become effective in such displays.

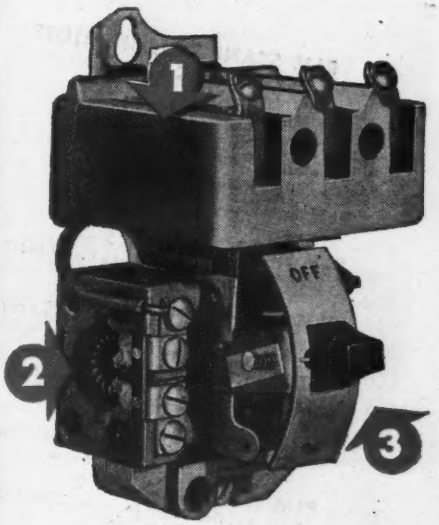
Island type show windows, or deep type windows with mirror glass backgrounds, should use reflector equipment carefully louvered or shielded both from front and rear view. Symmetrical type louvered reflectors in the center ceiling area are effective for this type of window.

Glassware displays may be effectively lighted from below, using glass floors for the display area. Care should be exercised in such displays to properly shield light sources and bright glass shelves from the view of window shoppers. Daylight type lamps add a highly desirable sparkle and appearance of whiteness to these displays.

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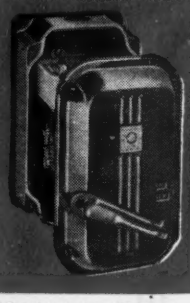
General-Purpose Indoor Applications —normal atmospheric conditions

"DE-ION" MOTOR WATCHMAN 10-100-S

NEMA Types III, IV & V

WATERTIGHT AND DUST-TIGHT CAST-IRON ENCLOSURES

(Rubber gasket between case and cover)



Outdoor applications including:

- Docks
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- Tunnels

Indoor applications including:

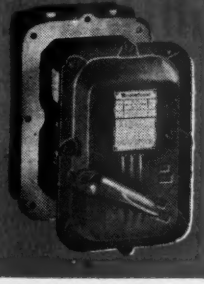
- Dairies
- Steel mills
- Breweries
- Cement mills
- Woodworking plants

"DE-ION" MOTOR WATCHMAN 10-100-W

NEMA Types VII & IX

CAST-IRON ENCLOSURE FOR HAZARDOUS LOCATIONS

Class I, Group D and Class II, Groups E, F & G (Ground flanges on case and cover)



- Refineries
- Distilleries
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"DE-ION" MOTOR WATCHMAN 10-100-U

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Same applications as standard sheet steel enclosures—where flush mounting is desired.

"DE-ION" MOTOR WATCHMAN 10-100-P

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48" Fluorescent Three-Lamp Closed-End Porcelain Enamel Unit

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48" Fluorescent Two-Lamp Open-End Porcelain Enamel Unit

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48" Fluorescent Three-Lamp Open-End Porcelain Enamel Unit

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★New RLM Approved Unit

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Hence the value of RLM Standard Specifications in establishing basic standards of efficiency, design and quality . . . and the RLM Label to identify lighting equipment built to meet these standards. This label certifies that the industrial lighting equipment on which it is affixed has been manufactured and inspected in compliance with the exacting procedure developed and administered by RLM Standards Institute.

Every RLM specification is drafted by a Technical Committee guided by the findings of the Illuminating Engineering Society, the recommendations of the *Better Light-Better Sight Bureau* and other recognized industry associations. These specifications are available without charge through manufacturers utilizing RLM inspection and certification service, or direct from RLM Standards Institute.

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MODERN LIGHTING

EXPOSED LAMP COLD CATHODE FLUORESCENT IN OFFICES

Use of lines of light in preference to individual lighting units is a natural outgrowth of the application of fluorescent light sources to today's lighting problems. This trend is accented in the use of cold cathode lamps for interior lighting.

When the E. F. Carlson Co., Inc., General Contractors of Springfield, Mass., decided to relight their offices and drafting room, they selected cold cathode to provide the desired lighting result. They wanted a higher intensity of light than was obtainable from incandescent light sources within the limitations of the wiring system of the office building in which their offices are located. Uniformity of light was also considered important, which would permit unhindered arrangement of office furniture and equipment. Shadows should be subdued, especially in the drafting room, and the lighting system should require as little maintenance as possible. Cold cathode fluorescent lighting met these requirements.

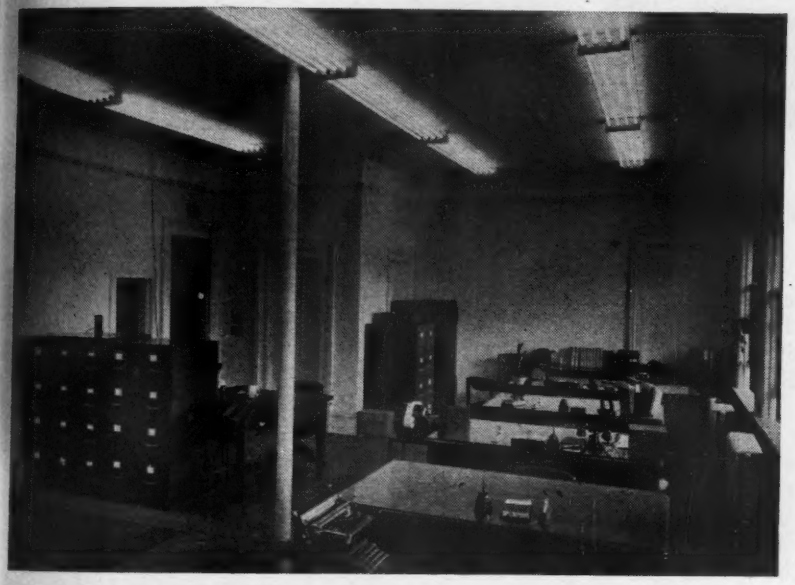


FIG. 1—Cold cathode fluorescent tubes provide 45 footcandles of illumination in this general office area of the E. F. Carlson Co., Inc., General Contractors, Springfield, Mass.

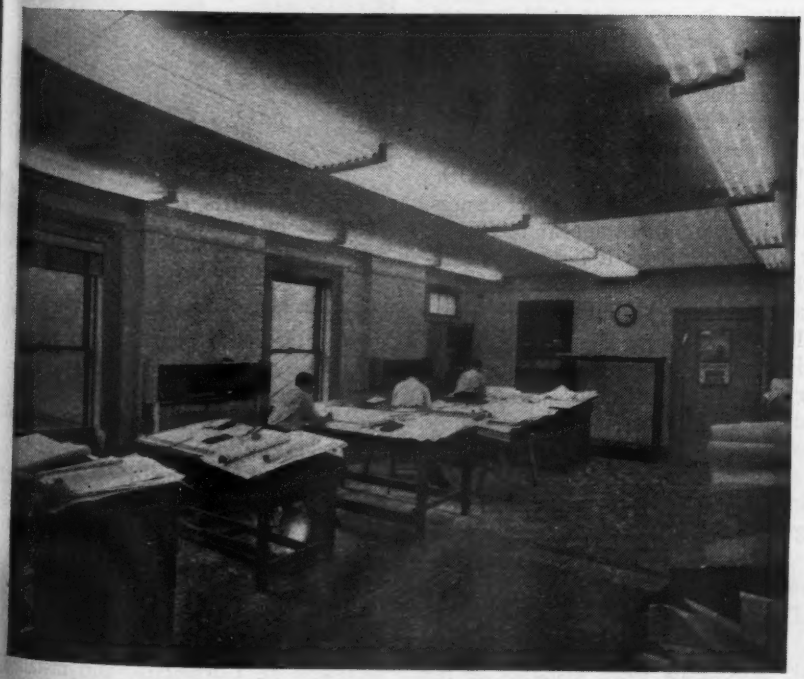


FIG. 2—Seventy-five footcandles of uniform, shadowless illumination is obtained on the drafting boards in the E. F. Carlson Company's drafting room. Heyman Electric Co., Springfield, installed the equipment.

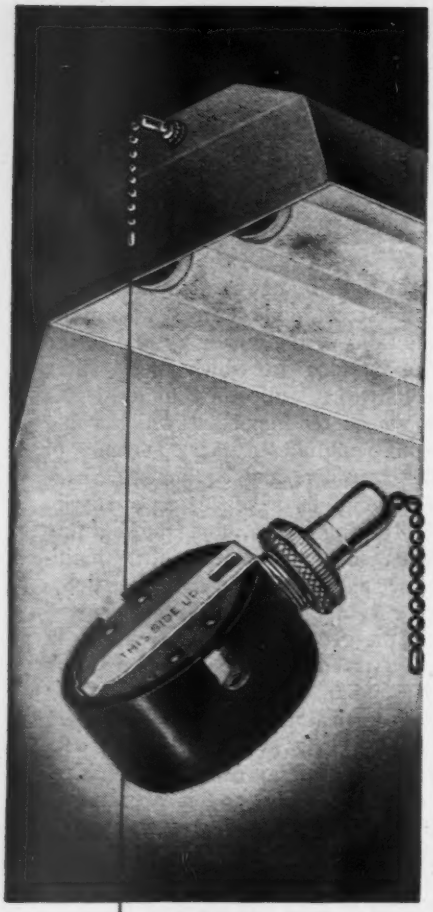
In the general office area, shown in Fig. 1, three continuous lines of four-row 25 mm. tubing were installed on the acoustical tile ceiling. The office is 32 feet long by 20 feet wide, with an eleven foot high ceiling. Each lamp is eight feet long, and is operated at 120 ma. current density, from 9000 volt and 12000 volt transformers. The resultant intensity is 45 footcandles, uniform at desk top level.

An unusual arrangement of the lighting equipment was used in the drafting room. Next to the outside windows one continuous line of four rows of lamps was located approximately two feet from the wall. Over the center of the drafting boards one continuous line of eight rows of lamps was used. Another continuous line of four rows of lamps was used for general illumination over the area adjoining the inside wall. This room is 36 feet long and 24 feet wide, with a 10 ft. 6 in. high ceiling. The cold cathode lamps were installed on the ceiling, which is acoustical plaster painted flat white. Each lamp is eight feet long, 25 mm. in diameter, 3500° white, and all lamps are operated at 120 ma. from 12000 volt transformers, concealed above the ceiling. A uniform, shadowless illumination of 75 footcandles is obtained in use on the drafting tables.

Lamps for this installation were furnished by the Redding Sign Company, Springfield, Mass., and the fixtures were furnished by Mobeco, Boston. Installation was made by Heyman Electric Co., Springfield.

CATHEDRAL RELIGHTS WITHOUT FIXTURES

In the Catholic Church the more elaborate ceremonies of the cathedral often require the church to be enlarged. This was true in the case of



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St. Joseph's Cathedral, San Diego, California, achieves a dignified, reverent atmosphere with indirect illumination from concealed reflector equipment, without the use of fixtures. Attention is focused on altar, highlighted with hidden floodlights.

St. Joseph's Catholic church in San Diego, California, when Most Reverend Charles F. Buddy was made bishop of that newly created diocese.

Bishop Buddy began improvements on the old church, and awarded the job of rewiring and relighting to California Electric Works, of San Diego. He proved to be well versed in construction, as well as modern in his ideas on lighting. He wanted ample light to read the fine print of prayer books comfortably. He also wanted to retain the dignity of the cathedral atmosphere, and felt that so-called "fixtures", or apparent light sources, would do much to mar that dignity. He insisted that the high beamed roof truss ceiling of the center nave be kept dark. Lanterns or fixtures should not be suspended from this high dark ceiling, as they would help destroy the feeling of height and spaciousness. The altar should not appear theatrical, yet should glow as if lighted by sunlight. Stations of the cross should be inconspicuously highlighted.

In order to meet these exacting requirements of producing light with dignity, V. R. Knight, manager of California Electric Works, called into consultation the Curtis Lighting engineer and local electric utility illuminating engineer for a planned lighting layout. The results are given in the following description of the subsequent installation.

On each 40 foot high side wall of the main nave, 200 watt Curtis adjustable floodlights were installed 30 feet from the floor. These floodlights were recessed in the wall behind lightly etched glass roundels mounted in



Lighting control is centered in 40 circuits on multi-breakers, located in vestry. Pushbuttons control motor driven windows.

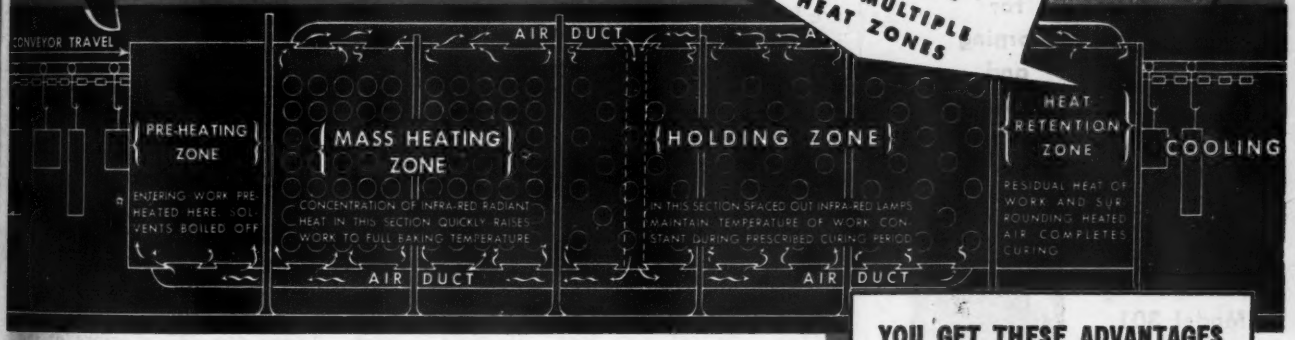
plaster rings. Each floodlight was then adjusted to project light to the fairly light-colored opposite wall. Because of the mounting height, no direct light is in the line of vision of the congregation, nor directed up to the dark finished beam ceiling. Each side nave is similarly lighted with the same type of equipment installed on the opposite side of the same wall 22 feet from the floor.

The altar lighting consists of fifteen 150 watt concentrated reflectors mounted on CurtiStrip, and installed along the front edge of the canopy. This canopy is 21 feet from the floor, 13 feet wide, extends out 7 feet, and

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is 3 feet deep, providing ample room for concealing the equipment.

Stations of the cross were lighted by a 40 watt lumiline lamp and reflector concealed in a niche below each picture, and tilted at a slight forward angle in order to provide more uniform reflection.

Lighting control was centered in a multi-breaker panel in the vestry near the altar. Lighting circuits are connected to permit one third, two thirds, or all lighting units to be switched on separately. This provides flexibility in lighting intensity to meet the varying requirements of the ceremonies. A total connected load of 36 kw. is used to light this church.

The lighting result in this cathedral is dignified, creating a reverent atmosphere, with an adequate uniform intensity to meet all visual requirements. Highlighting the altar from concealed sources of light provides the proper accent, focusing attention to this area. The spaciousness of the center nave is not broken by suspended fixtures, nor by exposed, glaring light sources. The lighting criteria established by the bishop have been met very successfully.

This prewar church lighting installation is an excellent example of *planned* lighting in the church. With the multitude of light sources, including new developments during the war, reflector equipment, diffusing media and new metals, which are now or soon will be available, it is possible to approach the vast church relighting market with new concepts in lighting. Study of outstanding examples of good lighting techniques such as that used to relight St. Joseph's Cathedral will pave the way to the development of other new techniques.

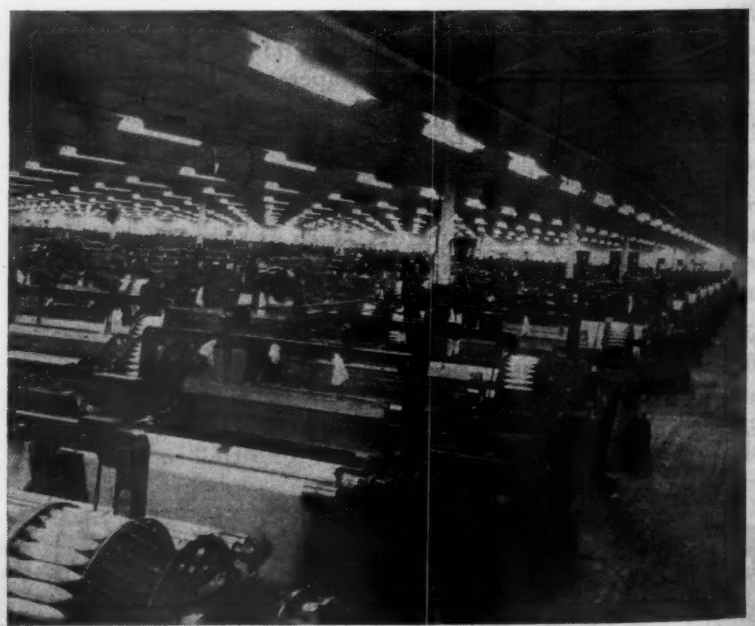
WEAVE ROOM MODERNIZES WITH CONTINUOUS FLUORESCENT

Efficiency in the weave room is measured by the ratio of the time machines are kept in operation. Speed in locating breaks in warp or filling threads is therefore important in keeping each machine running continuously.

The Soule Mills, New Bedford, Mass., was previously lighted to an intensity of four to six footcandles average, using incandescent industrial reflectors of various types. Individual reflectors were suspended on drop cords from the open wiring on the ceiling. All reflectors were installed approximately nine feet from floor. Illumination was fairly uniform, but the intensity was too low, and excessive direct and specular glare resulted.

In order to speed up production and achieve maximum efficiency with a minimum of rejects in the weave room, it was decided that the lighting system should be modernized. Working with the Electric Service and Sales Company of New Bedford, it was decided to install fluorescent lighting. Since a rewiring job was also involved, and it was felt advisable to provide for possible additions at a later date, a continuous wireway fluorescent lighting system was selected and installed.

The new installation consists of 27 rows of fixtures, each row 200 feet long. There are 24 reflectors of the



Weave room in Soule Mills plant, New Bedford, Mass. is efficiently lighted with 35 footcandles of uniform, diffuse illumination. Individual reflector units, spaced eight feet apart, are mounted on continuous wireway channels spaced nine feet on centers.

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Continuous wireway channels supported by suspension rods on eight foot centers eliminate individual outlets and two point suspension for each reflector unit.

open end type in each row, and each reflector is equipped with two 40 watt white fluorescent lamps. The intermittent spacing of reflectors on the continuous wireway channel permits more reflectors to be added at any future time when additional light may be needed.

Suspension rods support the continuous channels at eight foot intervals, and eliminate the many suspensions and individual ceiling outlets that would be required for installation of individual type fixtures.

The management reports that worker morale has been improved since this lighting has been in use. Loom breaks and repairs have been cut down, and production efficiency increased.

Engineering details of this installation are given in the following summary.

Engineering Data

Floor Area.....37,800 sq. ft.

Ceiling Height.....15 feet

Mounting.....Continuous wireway installed 9 ft. 0 in. from floor

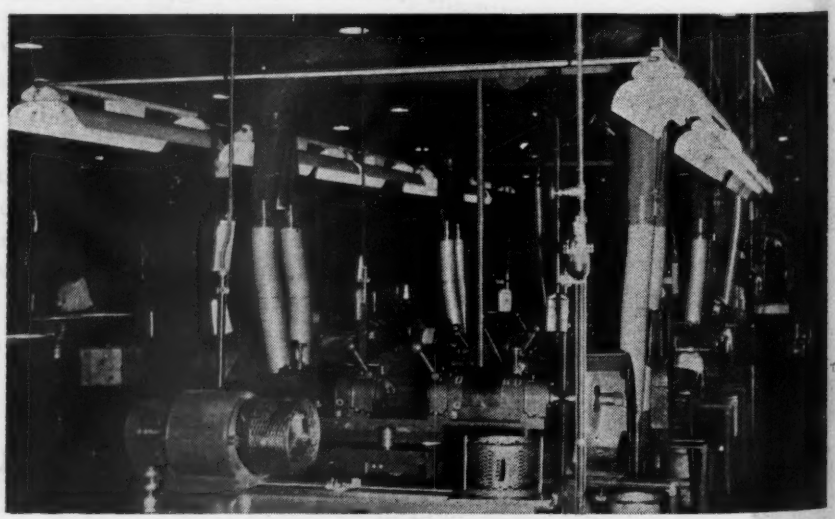
Spacing.....Rows are 9 feet on centers with individual reflectors 8 feet on centers

No. of units.....27 continuous rows with 24 reflectors in each row

Type.....Miller Company open end reflectors on medium weight "50 Foot Candler" continuous wireway.

Wattage.....61,560 watts total, including auxiliaries, or 1.63 watts per sq. ft.

Intensity.....35 footcandles, or an average of 21.5 footcandles per watt per sq. ft.



Concentrated supplementary lighting of 85 foot candle intensity (maintained) is provided by two rows of five, two-lamp, 40-watt, 3500 degree white fluorescent units for rough and finish grinding at the Chrysler operated Dodge-Chicago plant where B-29 engines were made. Units are mounted 7 feet above the floor with the center line of the fixtures about 9 inches from the edge of the grinders. Fixtures are suspended from angle-iron frame on 16-ft. rods and conduit fed. High intensity illumination was necessary to prevent changing contour of parts by grinding too deep.

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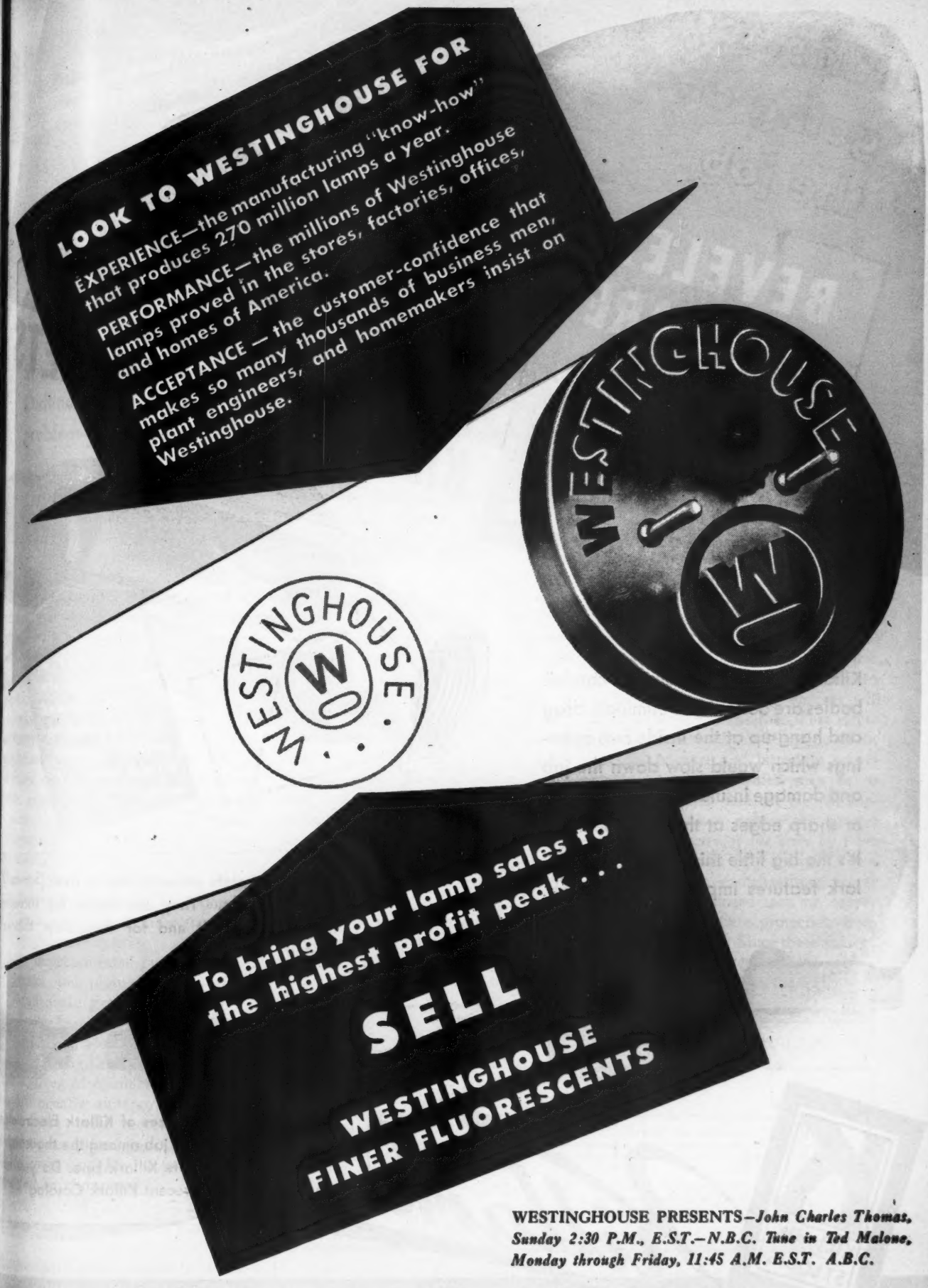
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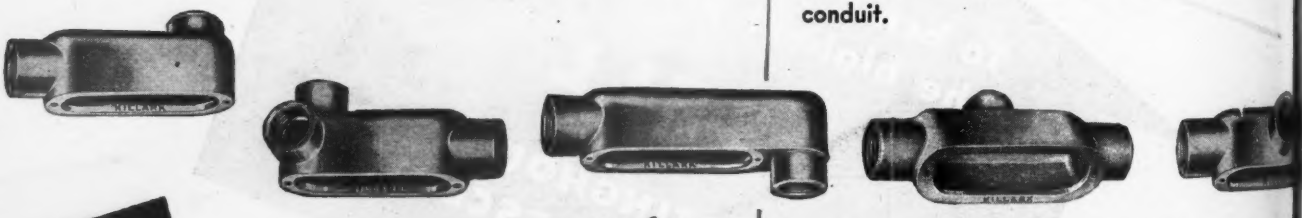
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The Control of Stray Currents

Stray currents corrode metallic equipment and accelerate deterioration of cable insulation. Outlined herein are the methods one prominent oil company uses to combat this maintenance problem—ideas applicable to many industrial electrical installations.

By John G. Buss, Jr.
Assistant Electrical Engineer
The Pure Oil Company
Chicago, Illinois

The effect of stray currents on electrical equipment, pipe lines, and sub-surface metallic structures is an economic and safety factor of the greatest importance. While stray currents do not involve the direct hazards of fire that static discharges do, they often result in the failure of vital equipment which, if it is used in the processing of volatile fluids, will have an equally disastrous effect.

Stray currents can be generated in so many different ways, and the effects can be so varied that it is often difficult to know exactly what the cause is and what corrective measures should be applied.

In general the most trouble is caused by relatively small currents developed in one or more of the following ways:

1. In cable sheaths by induction.
2. In sub-surface metallic structures by galvanic action.
3. In interconnected process vessels, tanks and piping because of an inadequate grounding system.
4. By leakage from electric railway systems or electrical machinery.

While it is quite true that there are other sources of troublesome currents, they are usually unimportant and will receive only brief mention. If the above four conditions are carefully considered, most troubles due to stray currents can be eliminated.

Stray Currents on Power Cables

Unnecessary power losses in underground cables, overheating and insulation failures are extremely vital problems in industrial plants where power bills are high, and cable failure means curtailed production.

When installing underground cable runs, two possible conditions contributing to cable trouble should be considered. The first condition is that caused by sheath and eddy currents in cables with metallic finishes. The second is due to electrostatic corona appearing as a surface discharge on non-leaded cables.

When a polyphase alternating current flows in an armored conductor, voltages are set up in the metallic sheath. *These voltages will cause eddy currents in three-conductor cables and circulating currents in single conductors.*

Normally, eddy current losses found in three-conductor cables are very small—less than five percent of the power current—and can be ignored.

In the case of single conductor cables carrying 3-phase power the results are somewhat different. When current flows in the conductors, induced voltages are set up in the sheaths by transformer action. If the sheaths of the three single-conductor cables are grounded at only one point, this voltage will appear between the sheaths and ground and will be proportioned to the length of the cable. If the sheaths are grounded at more than one point, the sheath voltage will be short circuited and a circulating current will flow between the sheaths. This circulating current will cause heating of the sheath and wire and introduce appreciable power loss which may be as great or greater than the normal copper loss. *It may reduce the current carrying capacity of the wire by from ten to 50 percent in the larger sizes.*

In addition to lead sheathing, armor sheaths of galvanized iron or copper are often used where protection from abrasion is desired. Since these finishes are usually used over the lead with a layer of jute in between the losses will be multiplied.

Table I gives average losses for single conductor cables with different fin-

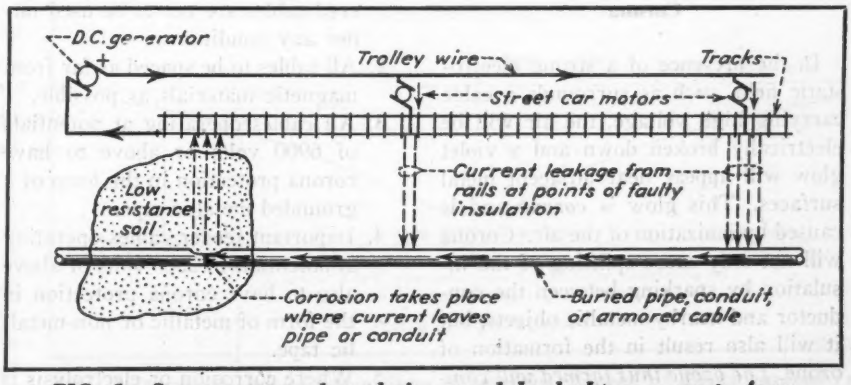


FIG. 1—Stray current electrolysis caused by leakage currents from a street railway system will corrode surrounding buried pipe, conduit and armored cables.

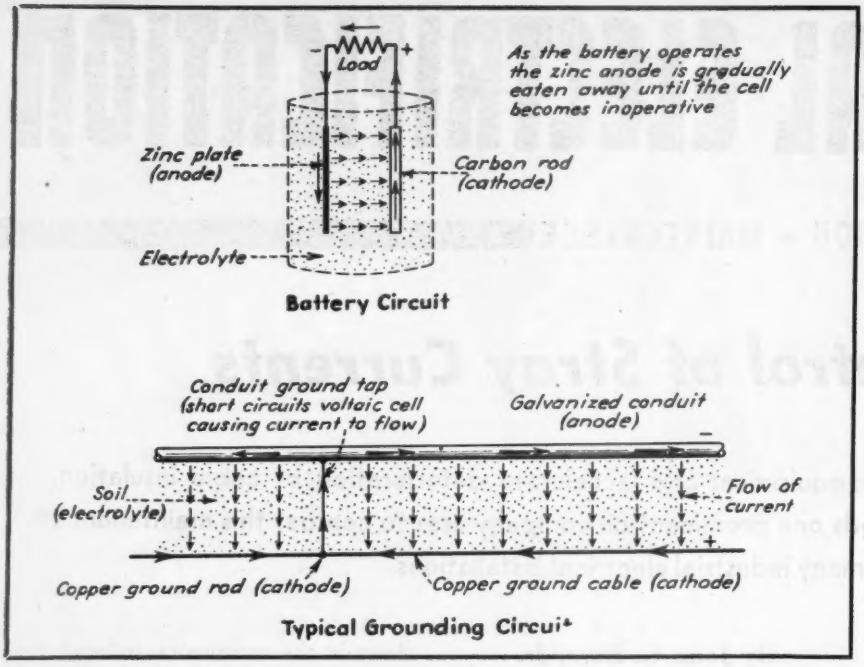


FIG. 2—Corrosion in a grounding circuit — where two dissimilar metals (buried in wet soil or soil having electrolytic properties) are mechanically or electrically connected — is compared with the current flow in a standard battery.

ishes operating on a three-phase circuit. An open-circuited, sheathed cable with no armor is taken as a reference and assumed to be carrying sufficient current to produce 1000 watts loss.

TABLE I—POWER LOSS IN CABLES

Type of Cable	Watts Loss
Conductor only (open circuited sheath) no armor	1,000
Short Circuited sheath operation —no armor	1,800
Lead sheath and copper armor—both short circuited	1,250
Lead sheath and steel wire armor—both short circuited	2,750
Lead sheath and flat band steel armor—both short circuited	12,000
Iron Pipe	25,000

Circulating currents can be reduced by the use of insulating sleeves, but this makes the installation expensive and complicated.

Corona

In the presence of a strong electrostatic field, such as surrounds a cable carrying high voltage, the air will be electrically broken down and a violet glow will appear near adjacent metal surfaces. This glow is *corona* and is caused by ionization of the air. Corona will not only cause splitting of the insulation by sparking between the conductor and nearby metallic objects, but it will also result in the formation of ozone. *The ozone thus formed will combine with any moisture present to form a strong acid which will attack most insulating impregnants and corrode metal structural members.*

This phenomena does not usually become troublesome at voltages below 6900, but it has been found responsible for the failure of cables operating at potentials as low as 2300 volts.

The best form of corona shield is a grounded metallic tape which affords positive protection against the building up of static charges and, consequently, prevents ionization. Where a metallic finish is not desired, a non-metallic, semi-conducting, corona-resisting tape may be used if the voltage is below 15,000.

Many years of experience and careful analysis of all cable failures has led us to the following standard rules in cable selection.

1. Three-conductor cables must always be used for polyphase power runs. Single-conductor lead covered cables are not to be used under any conditions.
2. All cables to be spaced as far from magnetic materials as possible.
3. All cables operating at potentials of 6900 volts or above to have corona protection in the form of a grounded metallic tape.
4. Important feeder cables operating at potentials of 2300 volts or above also to have corona protection in the form of metallic or non-metallic tape.
5. Where corrosion or electrolysis is a factor, specially prepared three-conductor cable should be used. This cable should have a primary lead sheath with bronze or copper strip armor applied over a jute bedding. An overall layer of asphalted jute will give final protection. Such a cable will be protected against corrosion, sheath losses and corona discharge.
6. Where induced sheath voltages may be high, treated duck tape over a lead sheath may be used to give protection against accidental short circuit of an open circuited sheath. A measure of corrosion protection will also be gained.

A factor in leaded cable failure which has not been discussed is that caused by galvanic corrosion or electrolysis. This will be taken up later.

Corrosion

The corrosion of metallic structures, pipelines, conduit and lead covered cables is one of the biggest maintenance problems that oil companies must deal with. All sub-surface metallic structures are subject to electrolysis and galvanic corrosion, and tests should be made at all such structures to determine if a corrosive soil potential exists.

It has been conclusively demonstrated that *electro-chemical action is responsible for corrosion.* This process occurs because of the inherent tendency of metals to revert to a more stable condition. For example, if metallic iron is placed in contact with water or any other electrolyte, the metal tends to go into solution in the form of electrically charged ions. Since the solution must remain neutral, an equivalent number of positive ions of another element must be displaced. In the case of iron, hydrogen is plated out and gathers on the iron surface in a thin film. The presence of this hydrogen film on the iron, if it remains, will stop the process of corrosion. Unfortunately, the protective film of hydrogen is destroyed either by its combining with oxygen to form water or by passing off as a free gas, and corrosion continues.

This corrosion of metal is very similar to the process of electro-plating, and it is apparent that an electric potential impressed on a metal in contact with an electrolyte will rapidly drive the metal into solution. Similarly, when electric currents prevailing on pipe lines or conduit are discharged into the soil, the iron passes into solution and the pipe gradually disintegrates. *Tests have shown that the amount of ferrous iron lost by electrolysis is always the same—about 20 pounds per ampere per year.*

For purposes of discussion this process of corrosion will be separated into three types—all of which involve the flow of electric currents.

1. The first type is that which takes place over a very small area of metal where, because of variations in soil and metal characteristics, one or more spots are at a higher potential than adjacent spots. For example, the presence of mill scale, rust or surface impurities will produce areas having different potentials to each other. The reaction in the presence of moist soil will be similar to that which takes place in an electric battery; that is, a difference of potential may be created by the action of any metal in contact with any acid, base, or salt. Under the above conditions current will flow from the place of high potential through the soil, which acts as an electrolyte, and back to the low potential spot on the metal. Where the current leaves the metal, the metal will be anodic with respect to the soil and will corrode. At the point where the current enters the metal, the metal will be cathodic and will be protected.

2. The second type of action is that in which the cathodic and anodic sections of pipe are separated by several feet or even miles. In this case, as a rule, two different types of soil having different resistances are involved. The current flow is the same as described above but usually leaves the pipe at a point of low soil resistance—such as wet or marshy land—and reenters the pipe at a point of high soil resistance. In these two forms of corrosion the electric currents are generated by galvanic action of the soil in contact with the pipe.

3. There is a third type in which the current reaches the pipe by leakage from an improperly grounded electrical system or an electric railway installation. A typical circuit illustrating this condition is shown in Fig. 1. This form of corrosion is called *stray current electrolysis.*

It should be noted that *in all cases it is direct currents that are responsible for corrosion.* Alternating currents, because they reverse polarity 120 times a second, tend to plate metal back on the pipe as fast as it is removed and no corrosion will take place.

To understand corrosion, a few general rules must be borne in mind. Corrosion of metal occurs where current flows from the surface of the metal into soil, and no corrosion takes place in the area where current flows from the soil into the metal.

If two dissimilar metals, buried in soil which is wet or has electrolytic properties, are connected together either mechanically or by means of a wire, an electric current will flow and one of the metals will tend to corrode. For example, if a galvanized conduit buried in wet soil is connected to a copper ground rod by means of a wire, current will flow from the conduit into the soil, through the soil to the ground rod and back to the conduit through the wire. Where current passes into the soil, particles of zinc will be removed from the conduit and mixed with the soil until eventually the zinc and conduit will be corroded away. In Fig. 2, this action is compared with the flow of current in a standard battery.

In the case of a leaded cable connected to a copper ground rod, the lead will tend to go into solution and in a highly corrosive soil may soon disintegrate completely.

Even in metals of the same type the use of alloys which may be imperfectly mixed is apt to cause spots on the surface which will act the same as dissimilar metals. The current will flow from one spot into the soil and back to a different part of the same metal, then through the metal back to the original spot. Where this current enters the earth the metal will gradually corrode away.

Scars and scratches on a metal surface exposing bright metal will often result in corrosion. The bright metal will be electro-negative to the unscarred surface and current will flow into the soil with resultant corrosion of the bright metal. When handling galvanized conduit that is to be buried in corrosive soil *care should be taken to avoid tool marks and unnecessary threading of the conduit.* Often conduits will corrode completely away at the threaded portion.

Theoretically, a metal which is electro-negative to another metal will tend to corrode away while the metal which is electro-positive will be completely protected. Actually, this is not always true. Often both metals will corrode. If a galvanized pipe is connected to a copper pipe the flow of current will be from the galvanized pipe into the copper pipe with rapid corrosion of the galvanized pipe. However, if the galvanized pipe does not supply enough current to protect the copper pipe, the copper pipe may also corrode because of scratch marks or surface impurities.

If additional electric current is supplied from some other source to the whole surface of the buried metal, corrosion will be eliminated. This additional current then can be supplied from plates of a dissimilar metal such as zinc or magnesium or by a direct current generator of some type. ***This is the basis for cathodic protection.***

If dissimilar metals are buried in the ground but are not connected together, little corrosion will take place. As soon as a metallic path is made between the metals, however, a current will flow and corrosion will start.

In most electrical installations it is essential that machines, structures, conduit and lead sheathed cable be bonded

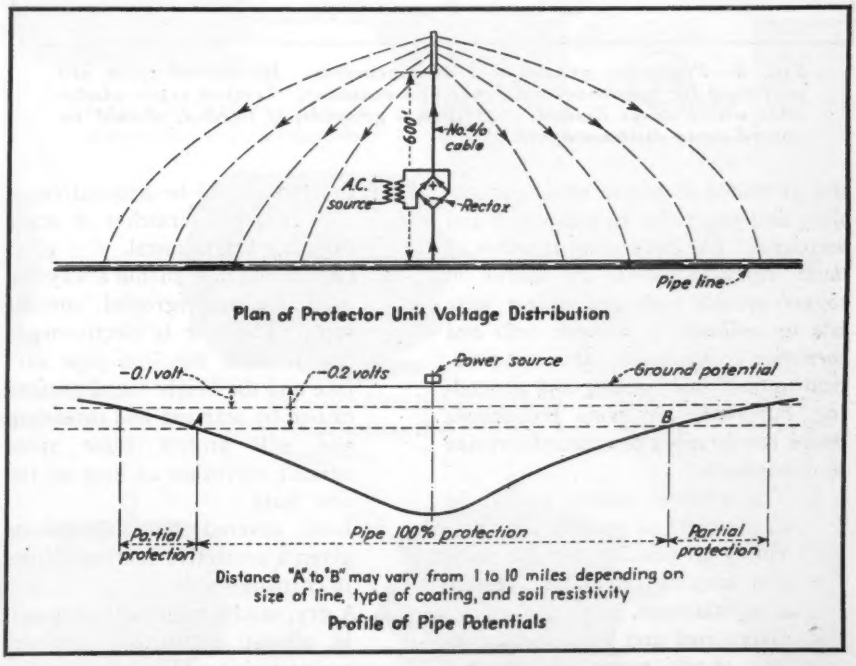


FIG. 3—Cathodic protection utilizes an external source of direct current (protector unit) and a ground bed to support current to the buried pipe. With current flowing into the metal, the metal is polarized and corrosion stops.

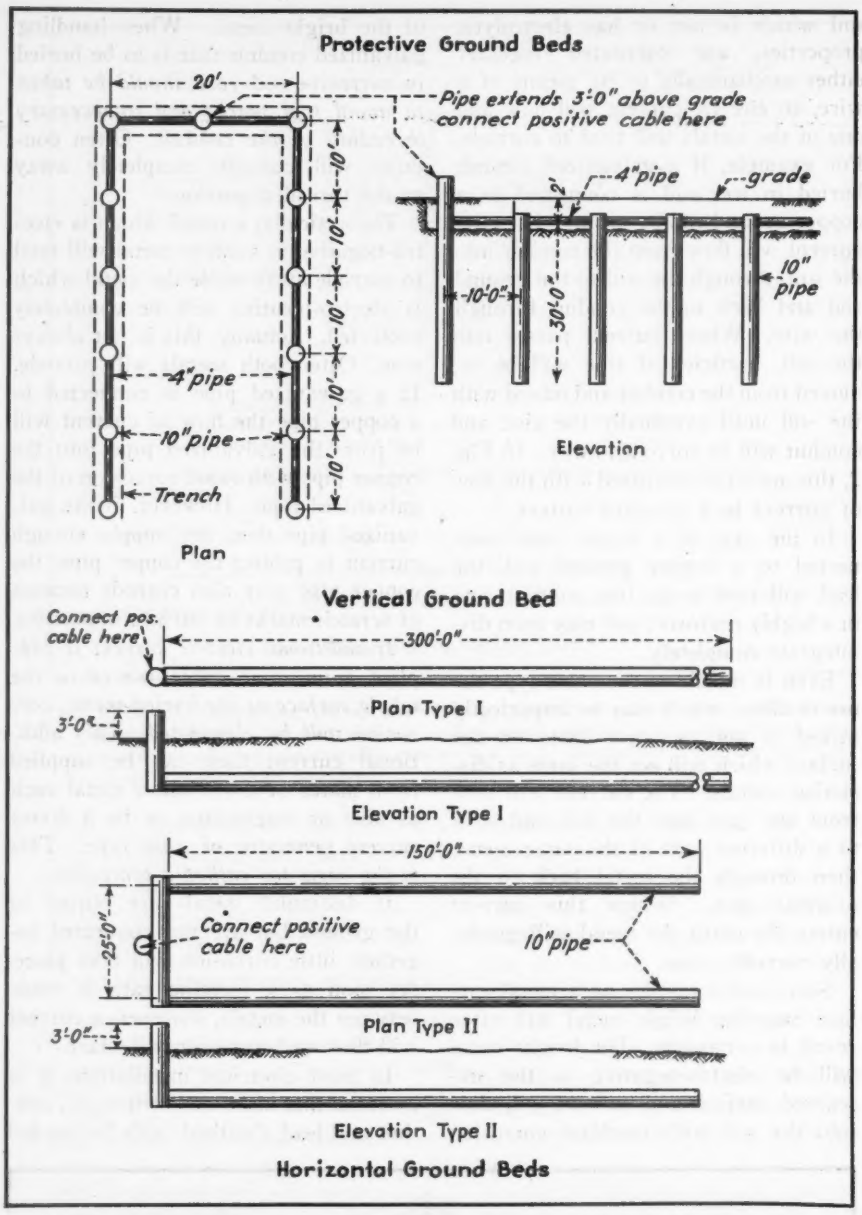


FIG. 4—Protective ground bed arrangements. Horizontal types are preferred for maximum efficiency and economy. Vertical types admissible where space limited. Additional grounds, if needed, should be spaced some distance apart.

and grounded to secure electrical stability and protection to equipment and personnel. *The connecting together of these different metals by means of copper ground rods and copper wire sets up millions of galvanic cells and corrosion is inevitable.* It is not practical to omit this bonding and grounding, but *there are some precautions which can be taken to reduce corrosion to a minimum.*

1. The ground system should be as complete as possible thus providing all possible metallic paths and keeping circulating current at a minimum.
2. Galvanized and black metal conduit should never be connected together in corrosive soils or atmospheres.
3. Conduit should be handled carefully to avoid scratches or scars exposing bright metal.
4. Galvanized pipe should always be used for underground conduit runs. The zinc is electro-negative to both the iron pipe surface and the bright metal surface caused by scarring and threading and will protect these spots against corrosion as long as the zinc lasts.
5. Lead covered cable should be given a protective coating of jute in corrosive soils.
6. A dry, sandy, high-resistance soil is almost completely non-corrosive and is an ideal medium for buried pipe or cable. Wet or acid soil should be avoided as far as possible. However, dry soil, while it is excellent as a corrosion preventative, is very poor as an electrical ground, and it may be necessary to treat the ground beds to reduce the resistance somewhat.
7. Where possible, dissimilar metals which must be electrically connected together should not be carried underground.
8. If corrosion of an underground system is severe, some means of supplying a protective direct current should be provided. This may be done by means of buried zinc or magnesium plates which, because they are electro-negative to most electrical materials, will give protection until they are completely eaten away. Where a large amount of protective current is required, a cathodic protection unit should be installed.
9. In many cases corrosion can be lessened by the use of pipe coatings of tar, asphalt, enamel or concrete. Coatings are not completely satisfactory because of the impossibility of securing a coating free from cracks or pinholes. Corrosion will probably take place at the cracks in the coating. However, the small amount of bare metal exposed will enormously cut down the amount of external current required to make the pipe cathodic.
10. The use of cinder fill should be avoided near conduits, cables or metallic structures. Cinders form strong galvanic cells in contact with most metals and cause rapid corrosion. In addition, cinders are apt to produce strong acids which may seep through the soil and further attack the metal.

The most effective method thus far devised for protecting buried pipelines, conduits, leaded cables and other metallic structures is a combination of coating or insulating the metal as well as possible from the ground and then adding cathodic protection to take care of any bare spots.

It is apparent that in order for a buried metal to discharge current into the soil with consequent deterioration it is necessary for the metal potential to be higher than the soil potential. If the metal potential is lower than the soil potential, current will flow into the metal from the ground, the metal will be polarized by constant formation of the hydrogen film and corrosion will be stopped.

In the case of buried pipelines it has

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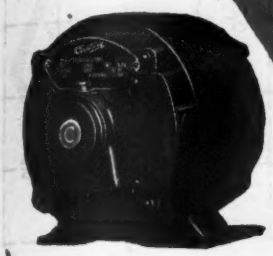
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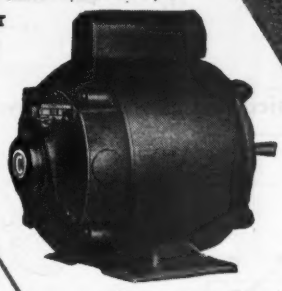
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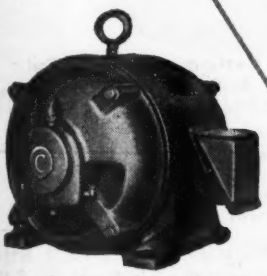
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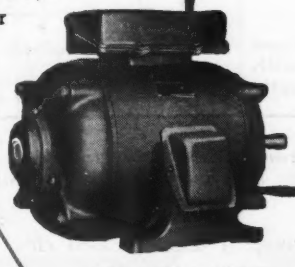
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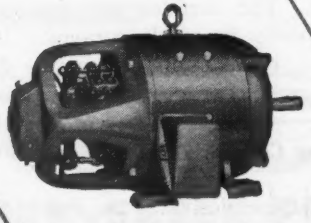
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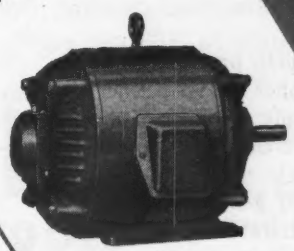
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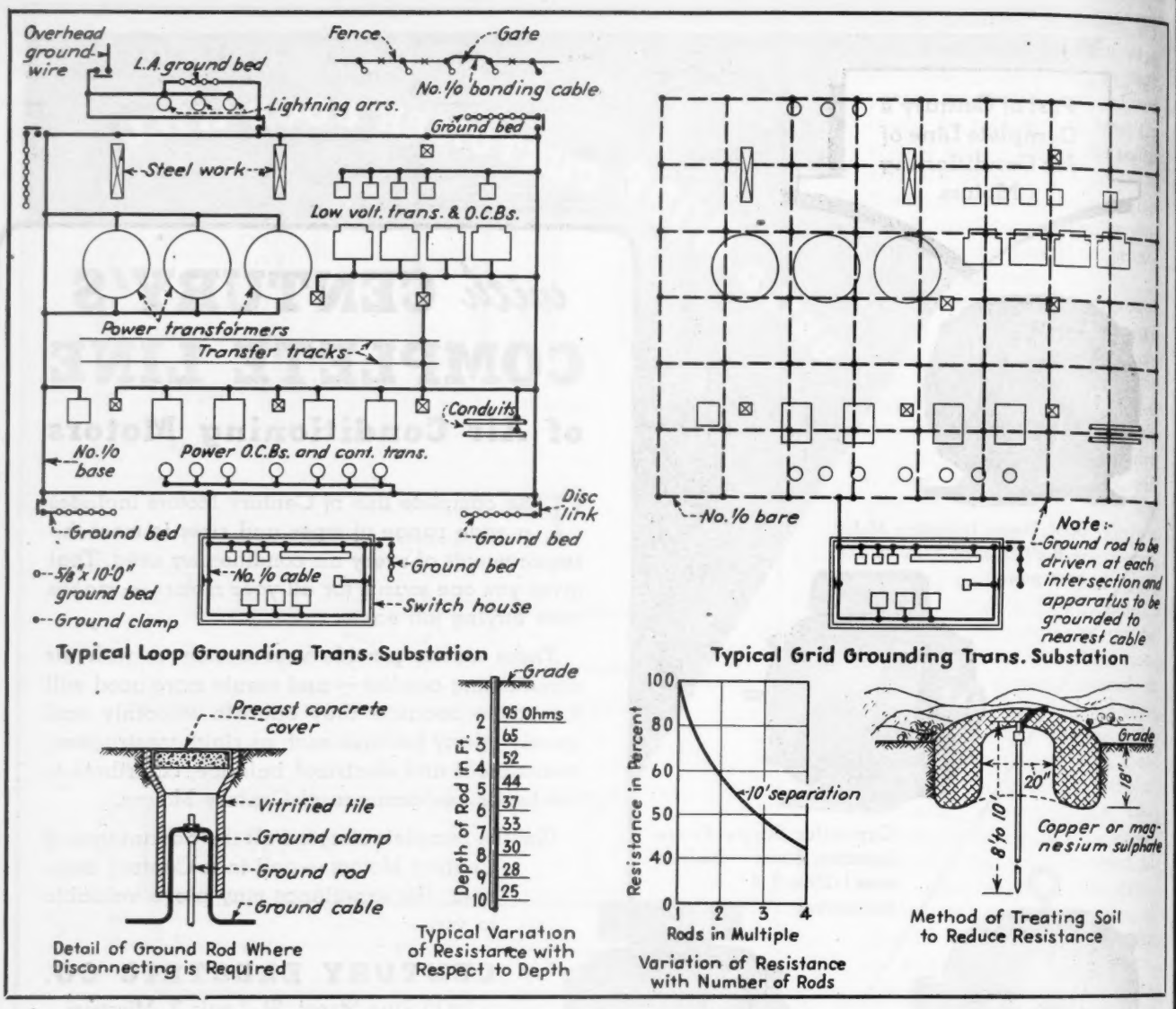


FIG. 5—Loop and grid grounding systems provide best protection and are recommended for all large installations. Grounding must be as carefully engineered as the rest of the electrical system.

been determined that *if the potential of the pipe is 0.3 volts or more negative with respect to the ground, complete protection will be attained.* Negative potentials of even 0.1 volt will give a high value of protection.

Cathodic Protection

An external source of direct current is usually used to elevate the soil potential and thus force current into the metal. Since the effect of this is to make the metal cathodic to the soil instead of anodic, it is called *cathodic protection.*

The usual cathodic protection system consists of a copper oxide rectifier or generator to supply a source of direct current and a ground bed to distribute it to the metal to be protected. In isolated areas, wind generators or gas-engine driven units should be used. The use of a number of small units in preference to one large one is recommended because of the increased efficiency and economy. Our own practice is to standardize on units of from 15 volts at 15 amperes to 30 volts at 50 amperes.

When the necessity for corrosion prevention is demonstrated, a survey must be made to determine the size and location of the protectors. It is impossible to make this determination mathematically. Actual field measurements must be used.

A satisfactory procedure for carrying out these measurements will be outlined below, assuming a pipe line is to be protected. The method will be exactly the same for tank bottoms, leaded cables, conduit or structural members.

Locating Corrosion Points

In making a pipeline survey the first thing to do is to determine the points at which corrosion is taking place. The most accurate indication of this is the intensity of current flow to earth at any point along the line. Measurement of this current can be made by means of an earth current meter but this is usually a difficult and complicated job. In most cases a sufficiently accurate determination of the proper location for protective units can be made by one or more of the following methods.

Soil Resistivity Method

The theory behind this method is that current developed in the pipe by galvanic action, following the line of least resistance, will leave the pipe and flow into the soil where the resistance of the soil is low. Actual tests using this method have shown quite accurate results.

The most satisfactory hand instrument for making these soil resistivity tests is the Megger ground tester, and the system which appears to give the

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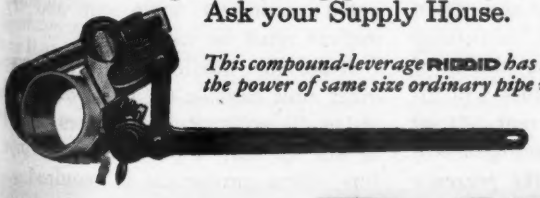
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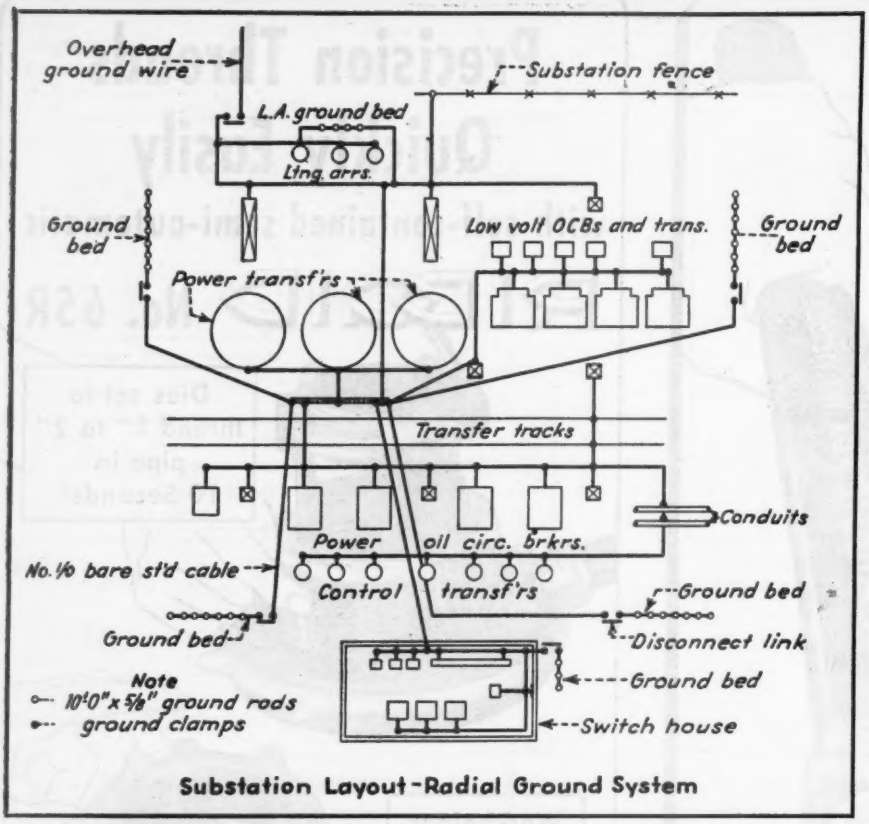


FIG. 6—The radial ground system should be used for small installations only. Principal drawback: a fault in one lead will isolate all equipment grounded by that lead and may result in dangerous potential difference between various ground points.

most consistent results is the four electrode method developed by Dr. F. Wenner and described in U. S. Bureau of Standards Bulletin No. 258, and also in the Megger instruction book.

Using this method and making tests approximately every 250 feet along the pipe line it will be possible to plot a chart showing soil resistivities. *At every point where the resistance of the soil is less than 2,000 ohms per cubic centimeter the need for protection is indicated.*

In addition, the line should be protected wherever it lies in ponds or streams where the water shows acidity to any degree whatever. Also, if the soil shows a definite acid condition, it is probable that protection will be required.

When hot spots have been found by using this method, they may be checked by one of the following procedures.

Current Measurement Method

The current measurement method can be used only on pipe lines where the coupling resistance is low, such as lines with welded joints or screw collars.

A millivolt meter similar to the Weston 1-B having several scale ranges between 0-10 mv. and 0-100 v. is required.

Tests should be made every 500 or 1,000 feet along the line using the following method: two contact rods with sharp tips are placed in contact with the pipe, making sure that good contact is established. The rods are separated by about 200 feet and one lead is brought from each rod to the meter. The potential drop in this section of line is measured and the current flow is calculated by dividing the voltage drop by the resistance of the pipe.

Exact values of current flow are not as important as the relative value. *The purpose of the test is to determine points at which currents are discharged. As readings are taken they should be plotted against pipe lenth.* Direction of potential drop will show direction of current flow and will point to a discharge. Thus, in any given direction of current flow, increasing values will indicate an accumulation of current and decreasing values will indicate a discharge of current. *At all points where there is a convergence of currents and a discharge the presence of corrosive areas may be assumed.*

The presence of stray leakage currents from electric railways or other electrical apparatus will introduce an error in the meter reading. If erratic results are obtained a recording millivoltmeter should be connected in the line for 24 hours and the average voltage, ignoring definite peaks, should be determined.

Soil Potential Method

In taking soil potential readings an extremely sensitive voltmeter must be used. Because the voltages are so low, any current drawn by the meter will result in an incorrect reading. An instrument having ranges between 0-0.2 volt and 0-2 volt and having at least 10,000 ohms per volt resistance will be suitable, or a vacuum tube voltmeter may be used.

Testing of soil potentials is usually done by connecting the negative pole of the meter to the pipe and the positive pole to an electrode set in the ground as close to the pipe as possible and on a level with the pipe.

The electrodes should be of the copper sulphate type similar to those manufactured by the Brance-Krachy Company. A correction factor will have to be introduced to offset the voltage developed in the electrode itself. If the net potential of the pipe is less than 0.1 volt negative to the soil, the presence of a hot spot is indicated. Where measurements are being made to determine current flow between leaded cable and ground, a lead electrode should be used instead of the copper sulphate type. If the soil is dry, a little water may be poured on the ground to reduce the electrode to ground resistance.

This last method of potential measurement will be accurate regardless of the resistance of the pipe joints. If possible, two or all three of these methods should be used.

In addition to actual tests, leakage records of the pipe line should be studied and compared with the computed hot spots. Sometimes it is desirable to unearth the pipe at several points and make an actual inspection for corrosion.

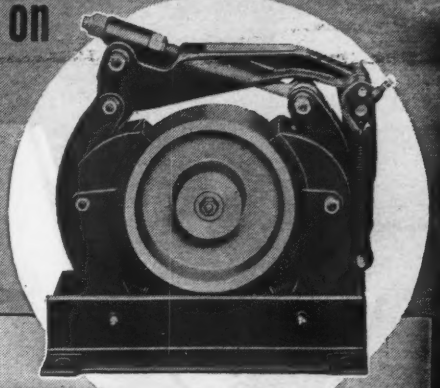
Size of Protector Unit

The size of power unit to protect a given section of pipeline cannot be computed accurately so a cut and try method must be used.

A portable welding machine or some other unit capable of a d-c output of up to 50 volts at 50 amperes should be set up near a portion of the pipe line where protection is required.

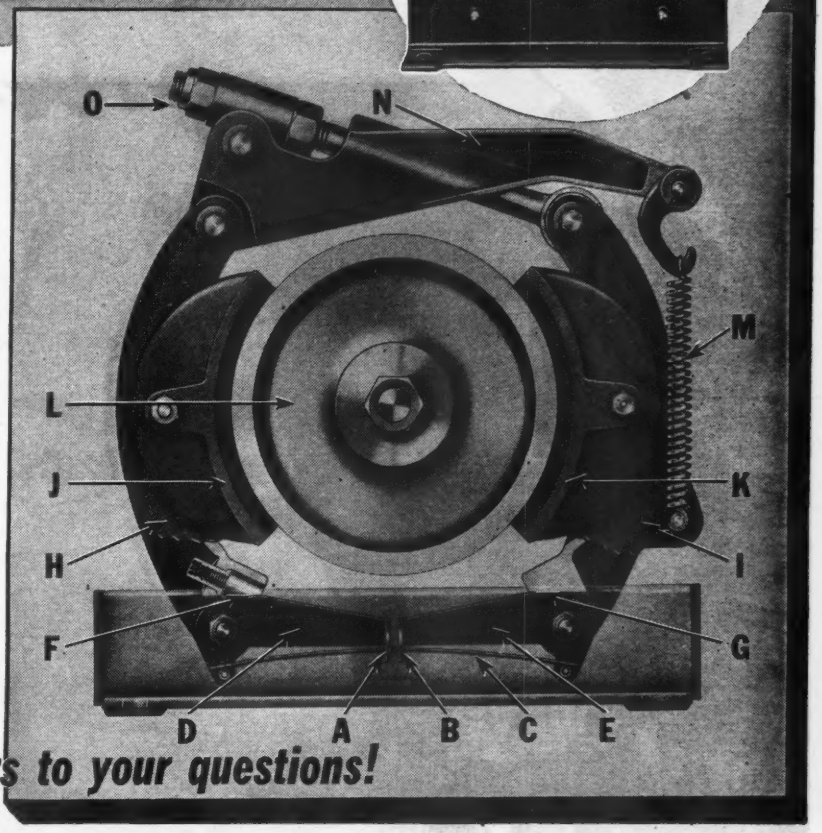
A ground bed consisting of two 10-foot lengths of 6-in. pipe or something similar is installed about 500 feet from the pipe. The positive side of the power supply is connected to the ground bed and the negative side to the pipe (See Fig. 3). The welding

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QUESTION: *How does the Self-Centering Device work?*

ANSWER: It works on the same principle as the swinging door—a spring returning the door to the same starting point, irrespective of direction of swing. When brake is released, spring M pulls down brake lever arm N, causing shoe arms H and I to be spread apart to clear brake wheel L. Spring C assures equal movement of both shoe arms, thus preventing either shoe from remaining in contact with brake wheel L.

Spring C presses equally against contact points A and B (which are equally distant from center of spring), moving equalizing arms D and E upward until they are in line with each other. Equalizing arms D and E press against shoe arms H and I at contact points F and G—and as the pressure is at all times equal, the shoe arms are moved out (away from the brake wheel) equal distances, carrying both shoes J and K equal distances away from the brake wheel L. Neither shoe can drag.

QUESTION: *Does Lining wear affect the self-centering device?*

ANSWER: No. When brakes are applied, shoe arms H and I move toward the brake drum L. Contact points F and G move downward, pressing equalizing arms D and E downward against spring C at contact points A and B. As the brake lining wears, contact points F and G move relatively farther, pressing equalizing arms D and E farther down. Spring C will be depressed to a greater degree—but when the brake pressure is released, spring C will bear equally against points A and B, and as explained above both shoe arms will be moved away from the brake drum equal distances, and the shoes are again centered as before irrespective of change in lining thickness.

QUESTION: *Are adjustments necessary to keep self-centering device operative?*

ANSWER: No, except when installed. This is done at contact point F by means of a set screw which is locked after shoes have been accurately centered. Wear factor at contact points is so insignificant that no appreciable change in centering of shoes will occur.

QUESTION: *How are shoes adjusted to compensate for lining wear?*

ANSWER: At point O where a "one-point adjustment" re-positions shoes to compensate for lining wear.

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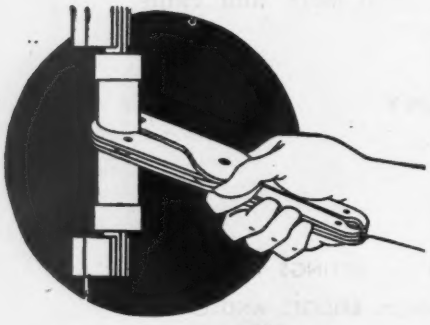
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machine should be set for about 35 amperes and allowed to run for 24 hours to permit conditions to become constant. When the unit has operated long enough to insure stable conditions, tests are made along the pipe line using the earth potential method.

It will be found that opposite the power source the pipe will be several volts negative to ground, but as readings are taken farther along the line voltages will be lower. A point will be located on the pipe at each side of the power source where potentials will register 0.3 volts. These points show the effective spread of the machine although the line will be protected for some distance beyond—probably down to 0.1 volt. The current and voltage can then be determined from the machine, and a cathodic protection device of the proper size installed.

Ground Bed

The ground bed should consist of 6-in. pipe or scrap metal. About 150 feet of 6-in. pipe will be sufficient for a 30-ampere output. It must be borne in mind that *the ground bed will disappear at the rate of 20 pounds per ampere per year and will then have to be replaced.*

The best location for the ground bed will usually be about 600 feet from the pipe and directly opposite a point where the pipe potential is considerably above the soil potential. The arrangement of the ground electrodes is important in determining the effectiveness of spread of the installation and is a point on which there is a great deal of disagreement. *Best results seem to be obtained when the ground electrode is placed in a horizontal line at right angles to the pipe line.* Where space is limited the scrap pipe comprising the ground bed may be placed in a double row. Using more than two rows, however, will reduce the capacity of the bed. Some suggested arrangements are shown in Fig. 4.

The cable connecting the protective unit to the ground bed should be at least No. 4/0 and may be run either overhead or underground. If the cable is run underground, it should be heavily insulated. "Trenchlay" is a suitable type.

Corrosion due to stray current electrolysis from leaky railway systems offers many special problems which cannot be considered here. It will be necessary for the corrosion engineer to work in conjunction with the railway to find a solution. *Usually properly insulating the track return current from ground will eliminate trouble.*

The only real protection agai static and stray currents is a g ground system which will remain sta and allow corrective measures to be plied with a maximum amount of s cess.

An efficient ground system is of t greatest importance in any electri installation, but it is particularly so areas where hazardous materials a processed.

It must be emphasized here that e fective grounding does not mean a h hazard arrangement of ground r and ground connections scatte throughout a plant area. While th might be satisfactory for a small ele trical installation where the prima purpose of the grounding is to lim the system potential with respect ground, it will not do for a large in with many metal structures, pipe transformers and motors. Here, whe a large area is covered, variations soil and pipe resistance and pipe vo ages developed by pumping operati can cause large amounts of curre to circulate.

If a difference of surface potenti is allowed to exist between vario steel tanks and process units, it likely that much sparking and arci will take place between the pipi connecting the different units.

Grounding systems can be divid roughly into three distinct classe Radial, loop and grid.

The radial system is the cheape but least satisfactory and should b used for small installations only. Th principal drawback of this system that a fault developing in any o lead will isolate all apparatus ground by that lead. This may result in dangerous potential difference betwe various ground points.

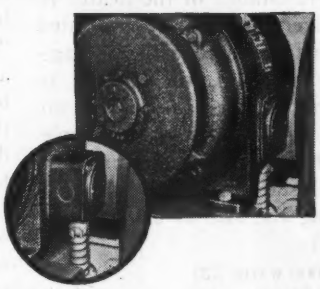
Grounding by the loop system give excellent results and is relatively ec nomical. Each piece of equipment ha a short path to ground and faults wi be dissipated in several directions pre venting isolation of equipment an serious potential variations. Becau of its effectiveness and economy th bus system is used for transform substations and large processing uni

The grid system is the best but mo expensive and is usually too elabora for any but the most critical jo where ground potentials must alwa be maintained within very close limi Typical layouts of the three differe systems are shown in Figs. 5 and 6.

Tests of many different groundin systems over a number of years hav led us to standardize on the bus metho either by itself or in combination wit one of the others.



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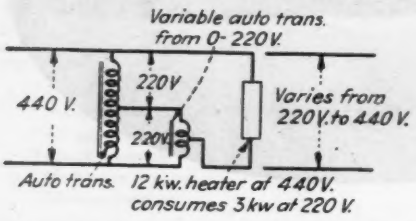
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READER'S QUIZ

AUTO-TRANSFORMER RATINGS

QUESTION 194—I have an electric heater which is supplied by a continuously variable auto transformer and an auto transformer such that the voltage on the heater can be regulated from



full voltage to 50 percent full voltage, as shown in the circuit. What minimum size auto transformer, and what minimum size variable auto transformer is required?—J.N.R.

A. TO QUESTION 194—The problem is an excellent illustration of the effect of voltage variation on a resistance load, of auto-transformer ratings, and of graphical solution.

The current "A" drawn by the heater will return to the line through the shortest path in one of the auto-transformers. The fixed ratio auto-transformer will be operating at a minimum (zero output) when the heater is connected for 440 volts. The variable auto-transformer will be operating at zero output when the heater is connected either for 440 volts or 220 volts.

At 220 volts, the fixed transformer must supply the 3 kw. drawn by the heater plus the no-load current of the variable transformer. Just before the 220 volt tap is reached, the variable transformer will be operating at its maximum kva. output, but at maximum current.

An auto-transformer is rated at its transformation voltage times the current output at that voltage. The transformation voltage is the "step-down" voltage in the case under consideration. The transforming winding also must be capable of carrying the rated current.

The accompanying curves show the current "A" drawn by the heater, the output "KVA" of the variable transformer and the load "KW" of the heater, from 220 to 440 volts. The transformation voltage "V" is used as the independent variable and forms the bottom scale of the graph. The corresponding voltage on the heater "E" is shown at the top. (V + E = 440.) A discussion of the construction of the curves follows.

From basic electrical formulas

$$I = W/E \quad (1)$$

$$I = E/R \quad (2)$$

Since the resistance of the heater is constant (given information indicates a purely resistance load with no magnetic circuit present), the current is directly proportional to the voltage on the heater. This plots to a simple straight line, so only two points are necessary to establish it.

Substituting the load at 220 volts in Formula (1)

A_{220} = 3,000 watts/220
= 13.64 amp.

At twice the voltage, the current would be twice as great, so

A_{440} = 27.28 amp.

A_{440} is plotted according to the "A" scale at the left at zero "V". (At this point, the heater is connected directly across the line, so there is no voltage of transformation.)

A_{220} is plotted according to the "A" scale at V = 220. (This is the first voltage of transformation, so the point strikes the right-hand margin.)

Connecting the two points just plotted with a straight line gives a graph which shows the current drawn by the heater from 220 to 440 volts. This line also gives information for further calculations.

Formula (1) may be rearranged to read

$$W = IE \quad (3)$$

By substituting current values "A" from the curve and the voltage applied on the heater, the watts load of the heater may be plotted. Points on the "E" scale at the top of the graph are arbitrarily chosen at random. Directly below these on the "A" line are found the corresponding current values. The decimal must be set three places to the left to convert to kilowatts.

For instance, choose 280 on the "E" scale. Directly below this is a point on the "A" line, which when projected to the "A" scale at the left shows 17.4 amp. Substituting back in formula (3) gives

$W = 17.4 \times 280$
= 4,870 watts or 4.87 kw.

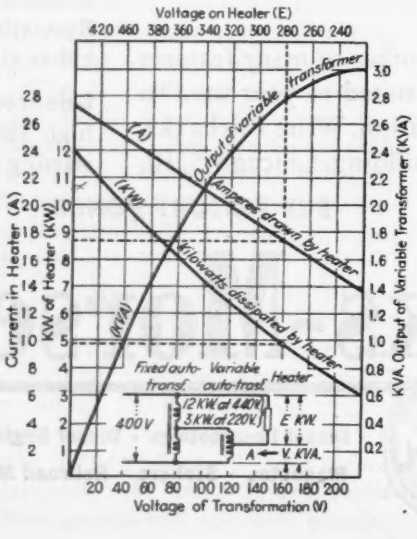
The point is so marked on the "kw" scale. After plotting several such points, they are connected with a smooth curve. This curve "kw" shows the kilowatts dissipated by the heater under the full voltage range as planned.

It shows the kilowatts to be 12 at 440 volts, but dropping off in proportion to the square of the applied voltage. This is proved by substituting equation (2) in equation (3) which gives

$$W = E^2/R$$

(This equation, or formula, by the way, is a valuable companion to $W = I^2R$. It often saves an extra step in calculations.)

The remaining interest is in the power output of the variable auto transformer. The voltage "V" applied to the transformer and "E" to the heater. (This is shown in the sketch.



Formula (3) read

$$W = IE$$

"V" is substituted for "E". Also, "A" is the symbol used so far for the heater current. Furthermore, to avoid confusion of symbols, VA is used to indicate the output of the transformer. So

$$VA = AV \qquad (4)$$

Several points are chosen at random on the "V" scale at the bottom. These are projected up to the "A" line to learn the current drawn by the heater at the chosen voltages of transformation. The corresponding voltage and current figures are multiplied together to derive the volt-amperes. (The process is much the same as explained for the "kw" curve.) For instance, at 100 "V", "A" equals 21.1 amp.

$$VA = 21.1 \times 100$$
$$= 2{,}110 \text{ volt-amperes or } 2.11 \text{ kva.}$$

Connecting these plotted points with a smooth curve shows the output curve of the variable transformer "KVA" over the planned voltage range.

Mathematically, this curve stems from equation (4)

$$VA = AV \qquad (4)$$

In equation (2)

$$A = E/R \qquad (5)$$

From examination of the connection diagram,

$$E = 440 - V \qquad (6)$$

Combining equations (4), (5) and (6) gives

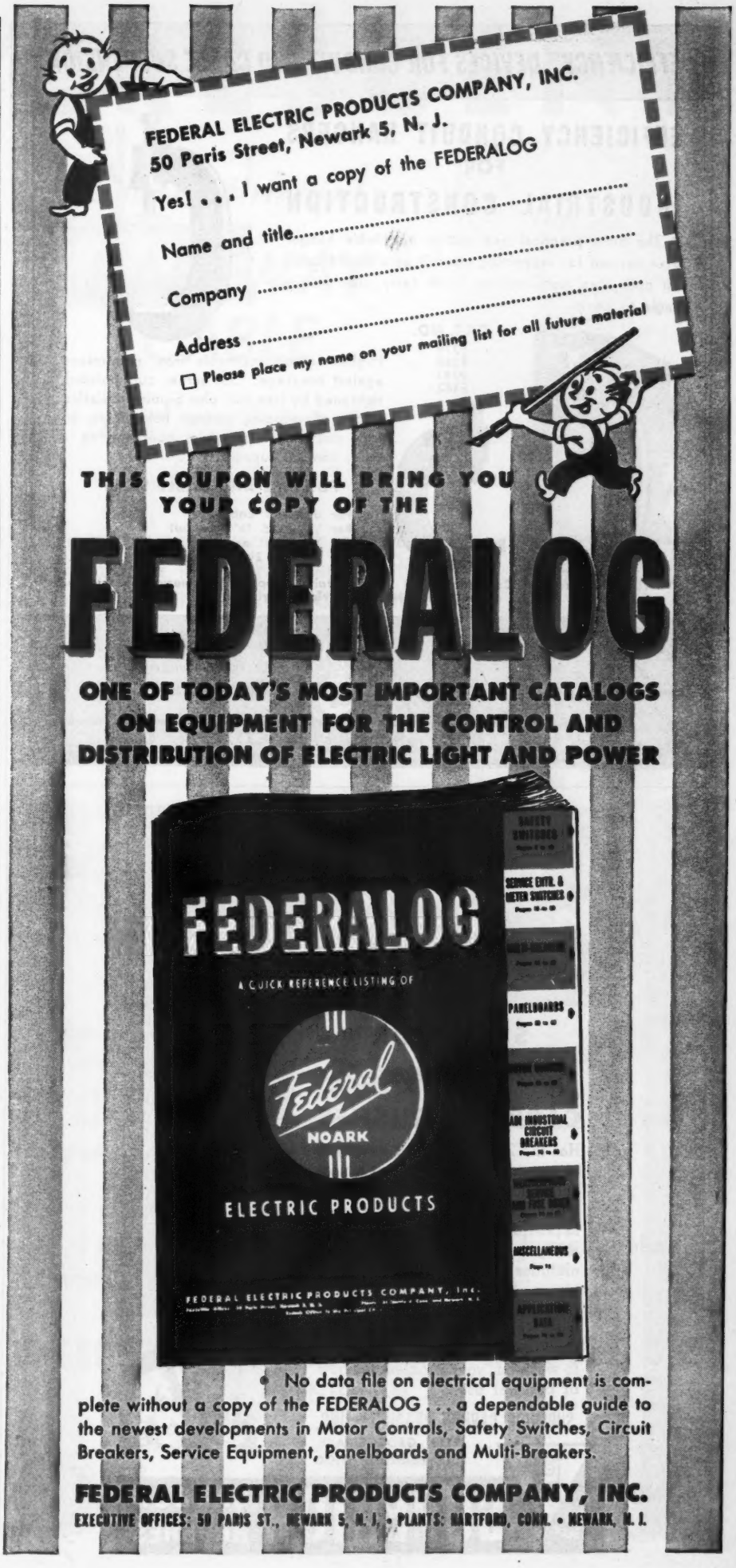
$$VA = (440 - V)\ V/R$$
$$= \frac{440V}{R} - \frac{V^2}{R}$$

This shows that the output of the variable transformer is proportional to the voltage of transformation less a value proportional to the square of the voltage of transformation. The first factor would govern the output of a well designed auto-transformer. But the expected output over the entire range is reduced in this case, because the heater load varies as the square of the voltage.

The final curve shows that a three kva. variable auto-transformer is necessary. The highest voltage tap must be capable of carrying about 26 or 27 amperes. The lowest tap must handle 14 or 15 amperes, depending upon the voltage.

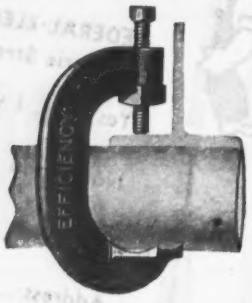
Some reduction in terminals could be effected by bringing out taps for only half the winding of the variable transformer. This saving is offset by two factors, (1) the untapped winding would have to carry a maximum of 20.5 amp. plus exciting current, and (2) the end connections of the transformer must be reversed when it is desired to move from one side to the other of 110 volts of transformation. No saving in iron would result.

By connecting the variable trans-



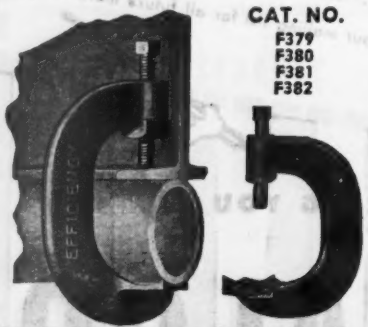
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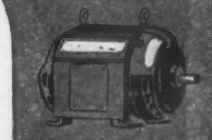
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former to the other line, the voltage on the heater can be reduced in steps to zero. The three curves would go to zero at V = 440. (The "KVA" curve also represents the output of the fixed transformer, excluding losses in the variable.) The variable transformer would have a new curve, cutting zero output at V = 220 and V = 440, and rising to a peak of 0.7 kva at V = 330. (This modification is not plotted and would occur beyond the right-hand side of the curves drawn.)

There may be some confusion as to why the "KW" and "KVA" curves do not coincide. The load of the heater depends upon the voltage applied to its terminals. The output of an auto-transformer depends upon the voltage of "boost" or "step-down" or the voltage *difference* between the primary and secondary lines. A striking example follows.

A 100 kva. 2200 to 220 volt transformer is capable of carrying a 455 amp. secondary load. By connecting the two windings in series, the line voltage can be boosted to 2420 volts (providing the bushings and other insulation were adequate). 2420 × 455 = 1100. An 1100 kva. conventional type transformer would be required to do the work of a 100 kva. auto-transformer connected to boost voltage from 2200 to 2420 volts!

Such striking advantages of auto-transformers, however, tend to disappear when the ratio of transformation becomes greater than two to one. Also, in the case of step-down auto-transformers, the hazards to life and property become greater than for conventional transformers.—L.E.B.

A. TO QUESTION 194—This problem is quite tricky.

Let us call the fixed, center-tapped auto transformer A, and the variable auto transformer B. Furthermore, let us assume that both transformers are loss free: they do not draw current to meet their copper and iron losses but only to supply the load. This load, incidentally, is

$$\frac{12000}{440^2} \text{ or } \frac{3000}{220^2} = 16.2 \text{ ohms.}$$

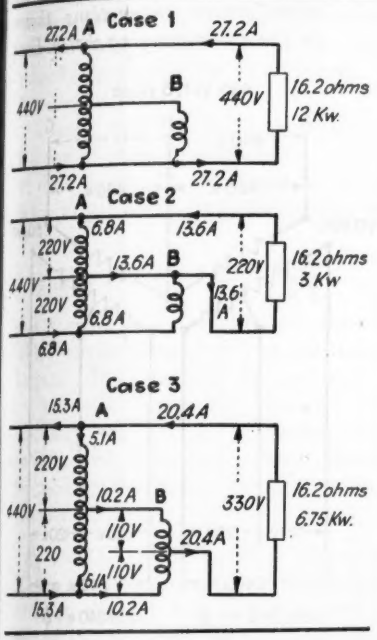
We study three cases, designated as 1, 2, 3. In case 1, the entire energy is supplied directly by the line, and both auto-transformers are inoperative. This case is trivial.

In case 2, the load voltage is reduced to 220 volts. Transformer A is fully operative; transformer B is inoperative.

Whatever the current divisions in the transformers, the load, 3 kw, must ultimately be supplied by the line. Hence, the line current, at 440 volts, is $\frac{3000}{440} = 6.8$ amps (losses disregarded). Consequently, the current through the

upper half of transformer A is the difference between load and line current: 6.8 amps.

In a center-tapped auto transformer, the currents in both halves are equal and opposite: The current in the lower



half of transformer A is 6.8 amps. also, and no current flows through transformer B. Hence, the rating of A, for case 2, is 2 × 220 volts × 6.8 amps = 3 kw.

In case 3, transformer B is in center-tapped position. The voltage on the load is 330 volts, the load draws 20.4 amps. (6.75 kw.) The line supplies 6.75 kw. at 440 volts: the line current is $\frac{6750}{440}$ = 15.3 amps.

The difference between load and line current, 20.4 − 15.3 = 5.1 amps, flows through the center-tapped, fixed auto transformer A. As mentioned under Case 2, each half draws the same current: 5.1 amps. But this is true for the transformer B also which now, in Case 3, is center-tapped. Each half of it carries half the load current: 10.2 amps.

In this case, the rating of transformer A is 2 × 220 volts × 5.1 amps = 2.24 kw., and that of transformer B, 2 × 110 volts × 10.2 amps = 2.24 kw. also. It is obvious that the greatest duty is imposed upon transformer B in the center-tapped position (330 volts on the load). For lower load voltages, the energy is supplied by transformer A; for higher voltages, directly by the line. Hence, the *rating of transformer B* (always disregarding losses) *is 2.24 kw.*

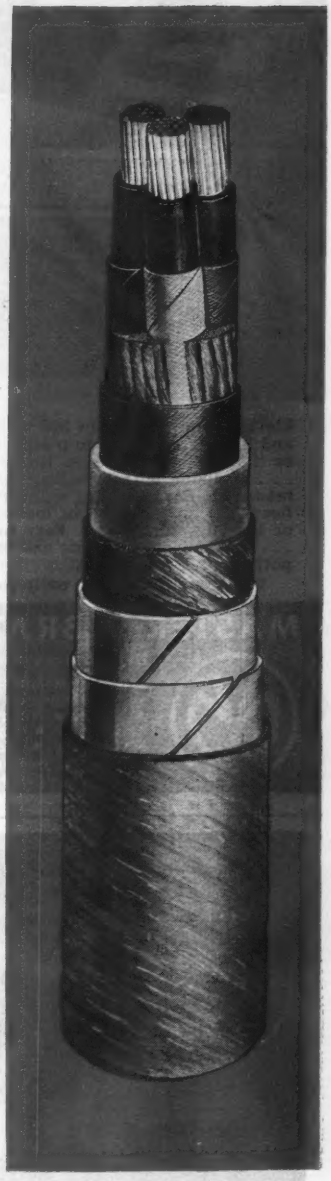
The maximum *rating of transformer A* (which is center-tapped to begin with) *is 3 kw* as obtained from Case 2. —L.F.R.

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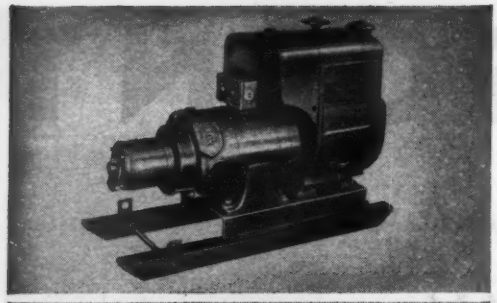
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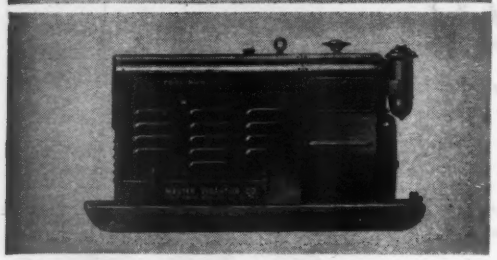
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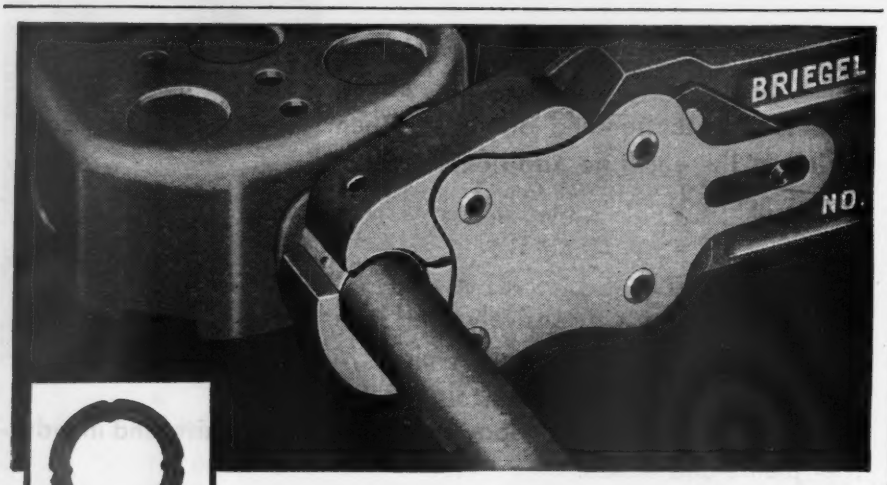
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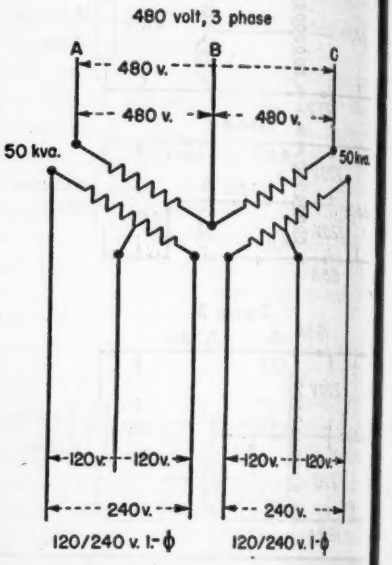
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TRANSFORMER CONNECTIONS

QUESTION 195—In changing over our plant lighting, which consists of both incandescent and fluorescent, I expect to use the transformer connections shown in the accompanying sketch. Each



single phase transformer is rated at 50 kva., and secondary circuits are not interconnected. How much load will each unit carry? What will be the primary currents in phase wires A, B and C, and what is the formula used in the calculation?—E.E.D.

A. TO QUESTION 195—Since the secondaries of the two transformers are not inter-connected, we can consider each transformer separately. A transformer of this size (50 kva) should have an efficiency of 98 percent. Since the load is to consist of both incandescent and fluorescent lighting units, we can assume the power factor as above 90 percent. The incandescent units have a unity power factor and if high power factor fluorescent units are used, their power factor will be 85 percent or better.

Each transformer can carry a load of 50 kva. or figuring the efficiency, 49 kva. secondary load. If we assume 92 percent power factor, the secondary lighting load for each will be about 45 kilowatts. The full load secondary current will be approximately 204 amperes.

Assuming the 50 kva. input to each transformer, the primary current for each will be $\left(\frac{50{,}000}{480}\right) = 104$ amperes and this will be the current for lines A and C. Line B will cary the sum of the two currents but since they differ in phase by 120°, they must be added

vectorially and the current in line B equals:

$2 \times I_p \times \cos 30° = 2 \times 104 \times .866 = 180$ amperes. Line B must be larger to carry this current.—J.E.W.

A. TO QUESTION 195—A quick practical answer to E.E.D.'s problem shows that these transformers may be expected to carry full rated capacity, governed by the amount of heat permissible.

A better method would be found in the use of three transformers, or one of three-windings, connected in closed delta, to get away from the phase unbalance.

Primary Current: $\frac{\text{Kv-a} \times 1000}{1.73 \times \text{E}} = \text{I}$, or 137 amps, plus excitation current which can be calculated if impedance is known. It is usually disregarded.

Fluorescent lamps will not give full efficiency without power factor correction, and induction motors should be used sparingly on these secondary circuits.—F.L.W.

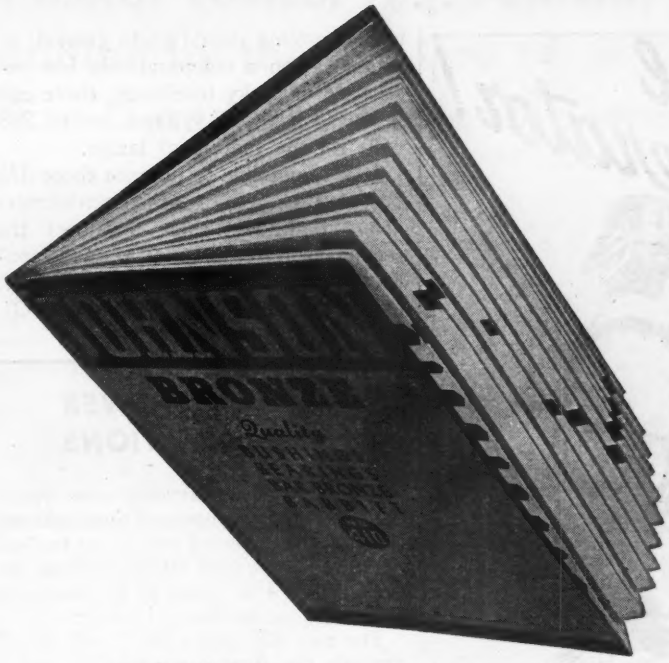
A. TO QUESTION 195—The connection as shown is an open delta on the primary and the equivalent of an open delta on the secondary. It is the opinion of many engineers that this is a very undesirable connection and should not be installed as a permanent system. Its chief merit lies in the fact that in the event that one of the three transformers in a 3 phase bank should break down, then the remaining two can be reconnected in open delta and service can be promptly restored.

With the open delta connection, the available capacity is approximately 57 percent of the initial bank or 86 percent of the remaining two transformers. In this case, 86 percent of 100 kva. = 86 kva. or 43 kva. each transformer.

Now if the connected load is, for all practical purposes incandescent and fluorescent (which has been power factor corrected) then the overall power factor should approach unity and the current $\text{I} = \frac{\text{W}}{\text{E}} = \frac{43{,}000}{480} = 89.9$ amps. per leg, on A, B and C.

As I have said, there are many serious disadvantages to this system, however, there is one in particular which should be considered here, and that is this.

Even though the secondary circuits are not interconnected, there will be a potential between the neutrals and if they are grounded, this will cause a serious hazard. And the potential between either neutral and some one particular phase leg of the other so-called single phase system will be 208 volts, and if these two individual single

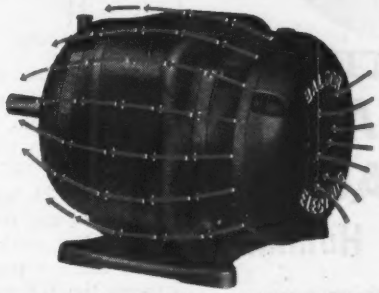


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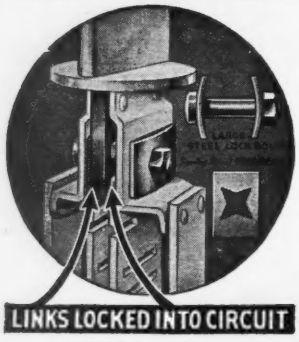
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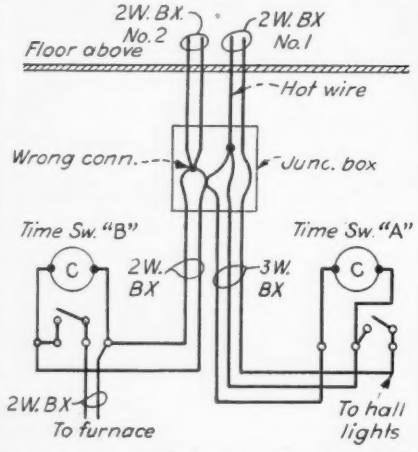
phase systems should go to ground, or even develop a comparatively low resistance or leaky insulation, there can be an impressed voltage up to 208 volts on the individual lamps.

If it is possible to procure three 37½ kva. transformers or three transformers above that size, then reconnect the secondary circuits for a wye connection, it is the writer's opinion that it would be highly desirable.—G.S.E.

Can you ANSWER these QUESTIONS

QUESTION T8—An apartment house owner here has two motor operated time switches, one on furnace control and one on the hall lights. They are both 60 cycle clocks, located about 4 ft. apart in the basement and connected as shown in diagram.

The two BX cables No. 1 and No. 2 through the floor are concealed and I could not trace their origin. However, I found a wrong connection in the junction



box as shown. Both wires in No. 2 BX are connected together for the neutral and one wire in No. 1 BX is the hot wire.

As soon as timer "A" is connected, it causes timer "B" to race and gain about 3 hours in 24, but when timer "A" is disconnected and replaced by a manual wind timer, they work OK.

Is there a possibility of induction between the BX cables No. 1 and No. 2 to cause this condition?—E.O.P.

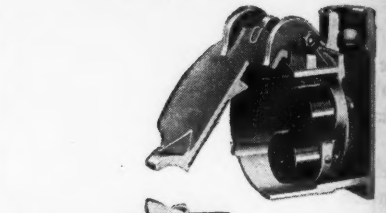
QUESTION U8—We have a 50 kw. generator that will not keep oil in the bearing opposite the drive end. This trouble started since it was last taken apart and cleaned.

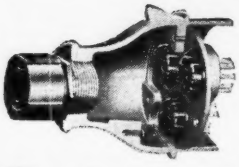
If the well is filled to the proper level while the machine is not running, and then started, the oil is all picked up until the oil ring will hardly touch the remaining oil. By adding more oil while running, it will bring up the oil level, but when the machine is stopped, the oil starts running out of the oil cup and shaft until all the oil is syphoned out of the well.

What causes this trouble, and how can it be remedied?—F.F.

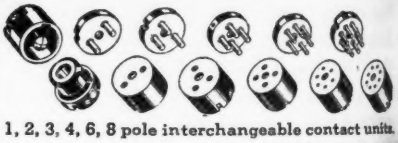
PLEASE SEND IN YOUR ANSWERS BY DECEMBER 1

MULTIPLE UNIT plugs and receptacles





3 unit sectional view.



1, 2, 3, 4, 6, 8 pole interchangeable contact units.

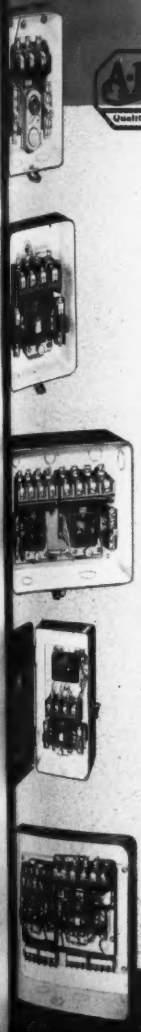
Any combination, 2 to 32 poles, for thermocouples, sound equipment, remote controls, lighting and motor wiring. Interchangeable contact units—1 to 8 poles—can be assembled in 2, 3, or 4 unit plug shells and receptacle housings to make any desired combination of circuits. Equipment can be arranged with the protected female contact units in either plug or receptacle, for safety in line side of the circuit. Ground protection is provided. A full line of plug shells, cable connectors, and standard receptacles allows the widest range of assembly combinations, to meet any needs. Consult your Pylet catalog for complete specifications.

THE PYLE-NATIONAL COMPANY

1344 N. Kostner Avenue, Chicago 51, Illinois

80% of all motor control requirements can be handled by the A-B line of Size 0 and Size 1 solenoid starters





MANUAL STARTER with two overload breakers. Has only one moving part.

AUTOMATIC STARTER for push button or limit switch machine tool control.

REVERSING SWITCH mechanically and electrically interlocked. Overload protection in forward or reverse.

COMBINATION STARTER combines disconnect unit and starting switch in one enclosure. Cover can be padlocked.

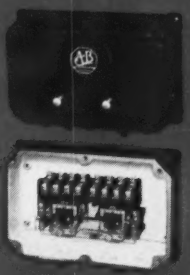
MULTISPEED STARTERS for 2-, 3-, and 4-speed multispeed ac motors.

Trouble-free Starters for Every Industrial Application

Here is an amazingly complete line of small a-c motor starters that will take care of 80% of general industrial motor control requirements. Size 0 units handle motors up to 2 hp from 220 v to 600 v, and Size 1 units are rated up to 5 hp, 220 v, and 7½ hp, 440, 550, 600 v. Five popular types are shown at the left, all mounted in standard NEMA Type 1 black enameled steel cabinets with white interiors.

Enclosures for Every Service

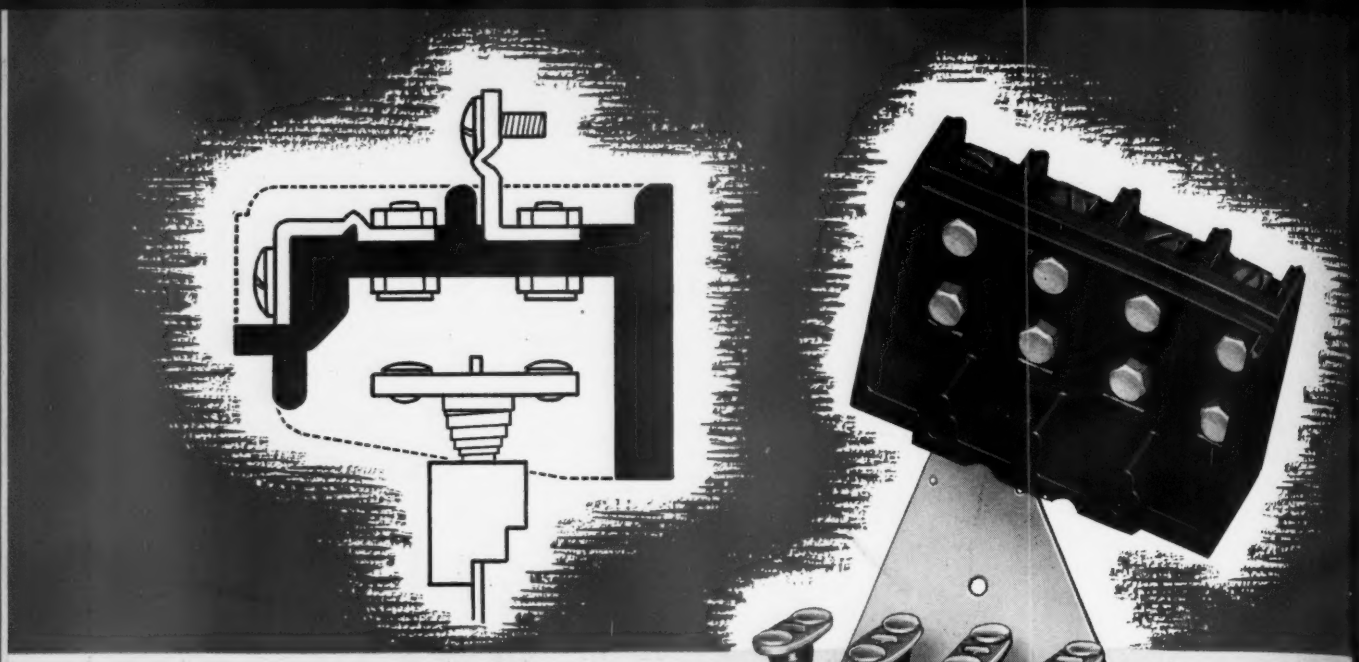
To meet special service requirements, standard cabinets are available for water-tight, dust-tight, gas-proof, and other unusual applications. There are enclosures, too, for machine pedestal mounting and wall installations. A wide variety of push buttons and limit switches can be selected from standard A-B catalog listings for remote control. Write for catalog today.



ALLEN-BRADLEY

SOLENOID MOTOR CONTROL

QUALITY

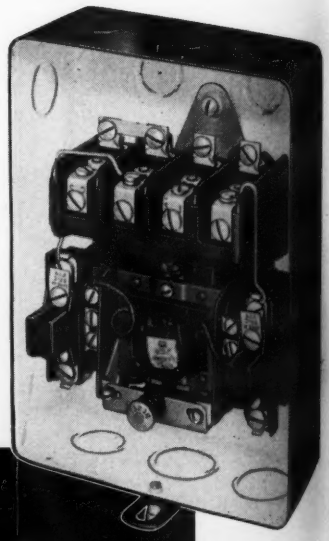


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So Simple ...So Trouble-Free!

Only ONE moving part . . . the simple magnetic plunger with the double break moving contacts. Like all Allen-Bradley solenoid starters, these Size 0 and Size 1 starters have no pins, pivots, or bearings to corrode . . . no jumpers to break. And the patented silver alloy contacts require no cleaning, filing, or dressing. You can install these starters . . . and forget 'em. Send for Bulletin 709.

Allen-Bradley Co., 1316 S. Second St., Milwaukee 4, Wis.



ALLEN-BRADLEY
SOLENOID MOTOR CONTROL

How to Check Fluorescent Components

[FROM PAGE 51]

the current to such an extent that the incandescent lamp will appear dim.

(b) *Continuity Check*—With the switch in position, No. 1, the 7½ watt lamp should light, indicating continuity on the following combinations of ballast leads. This can be seen by tracing the circuit shown in Fig. 7. Failure of the lamp to light with any of these combinations indicates an open circuit in the corresponding part of the ballast.

Leads	*Circuit*
Black to White	primary of auto-transformer
Black to Blue	position of auto-transformer and choke coil
Black to Outside Red	position of auto-transformer and choke coil plus condenser combination
Yellow to Middle Red	starting compensator

(c) *Ground Test*—With switch on position No. 1 and one of the test leads grounded to a bare spot on the ballast case, the other test lead should be connected in turn to each of the ballast leads. If the lamp lights with any of these combinations, it indicates that there is a ground in the ballast.



New Wisconsin code is being thoroughly studied by (L to R) E. W. Storm, Supt. of Water and Light Dept., Algoma, Wis.; and A. W. Lipske, electrical inspector of Menasha, Wis. at a recent meeting of Wisconsin Chapter, IAEI.

KLEINS

CHOICE OF MEN WHO *KNOW*... *Good Tools!*



Here are two sturdy tools—back from the war—ready to aid linemen and electricians with their peacetime jobs.

Some will choose the husky 201, favorite of "men who know good tools" for generations. Others will prefer the streamlined 201-NE with the rounded nose that gets into confined spaces and won't nick wires.

But whichever Klein they select, they are sure of getting the maximum in tool life—tool comfort—tool quality.

Klein Pliers are being made as rapidly as we can produce them, but naturally it will take some time before everyone can be supplied. Place your order with your jobber and he will fill it as soon as he can.

ASK YOUR SUPPLIER

Foreign Distributor: **International Standard Electric Corp., New York**



Since 1857

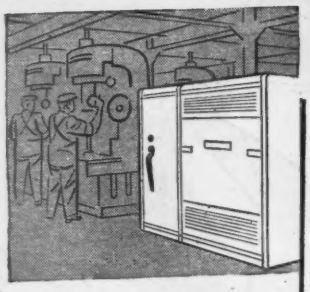
This book on the care and safe use of tools will be sent on request.

Mathias KLEIN & Sons

Established 1857 — **Chicago, Ill., U.S.A.**

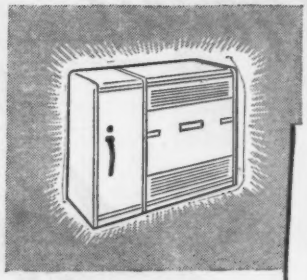
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AIR is today's best insulating medium for ... transformers



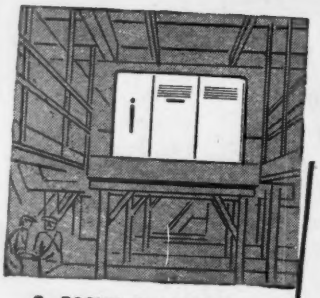
1. SAFER

Air cooling eliminates fire and explosive hazards. No inflammable liquids—no internal gas pressures, because no sealed tank is needed.



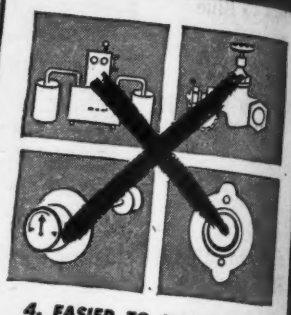
2. CLEANER

Air cooling does away with liquid seepages and liquid reconditioning. Coils easily cleaned with compressed air when used in very dirty atmosphere.



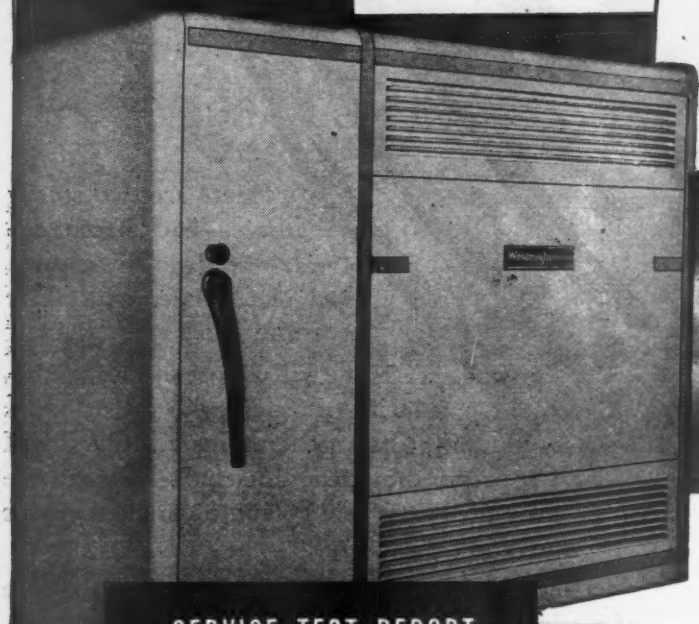
3. EASIER TO INSTALL

Air-Cooled Transformers need no vaults, catch basins or relief vents. Install them anywhere —on the floor or overhead.



4. EASIER TO MAINTAIN

No time out for liquid inspection, filtering or reconditioning —no pipes, fittings, valves or gaskets to maintain with Air-Cooled Transformers.



SERVICE TEST REPORT

WITHSTANDS 95% HUMIDITY

In the tropics, a Westinghouse 150 kva Air-Cooled Transformer has been operating continuously for two years in an atmosphere that remains constantly between 95% and 98% humidity. Transformer is loaded 6 days a week and remains energized over the week end. Condensation conditions are severe, but to date, there have been no indications of insulation deterioration.

Since 1936 the trend of transformer design for indoor applications has been towards AIR COOLING. Four important reasons why are shown here.

Westinghouse Air-Cooled Transformers and Power Centers are in service today in all types of industrial plants, under widely varying extremes of conditions in all climates from subarctic to the tropics. Their service records are major reasons for today's acceptance and demand for air cooling in indoor transformer installations. For details, write for booklet B-3459, "Air Cooling". Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa.

J-20481

Westinghouse *Air Cooled* TRANSFORMERS

Answered by
F. N. M. SQUIRES
Chief Inspector
New York Board of Fire Underwriters
New York, N. Y.
and
GLENN ROWELL
Electrical Engineer
Fire Underwriters Inspection Bureau
Minneapolis, Minn.

QUESTIONS ON THE CODE

GROUNDING AN OUTSIDE METER SOCKET

Q. *"In our town the utility has decided upon outdoor metering. I cannot find anything in my copy of the Code which governs the method of grounding an outside meter socket. Inasmuch as most services will consist of cable and not conduit, will it be necessary to run a special grounding wire between the meter socket and the service entrance switch cabinet?"*

A. No, the meter socket may be grounded to the identified grounded neutral conductor. This permission will be found in the supplement to the 1940 edition of the Code, under a new section 2559 added to the Code by interim amendment No. 54 approved on June 22, 1942. The provisions of this new section are as follows: "The grounded service conductor on the supply side of the service disconnecting means may be used for grounding meter housing and service equipment. The grounded circuit conductor on the load side of the service disconnecting means shall not be used for grounding equipment, cable armor, or metal raceways except as provided in paragraph 'C' of Section 2556, in Section 2559 and in Section 3372." The first reference pertains to the use of the identified neutral for grounding of fixed equipment only when special permission has been granted by the authority enforcing the Code; the second reference pertains to the grounding of the frames of electric ranges to the neutral; and the third provides for the grounding of distribution cabinets to the neutral conductor when nonmetallic sheathed cable containing a bare neutral is used.—G.R.

BRANCH CIRCUIT

Q. *"I contemplate running a three-wire No. 8 trench lay cable between the house and the barn to fit a 3 hp. 220 volt motor, a half hp. 110 volt motor and some 110 volt lights. I also desire to have some lights controlled by three-way switches at the house and at the barn. Would it be permissible to use a two-wire No. 12 trench lay cable between the house and the barn as the runners between the three-way switches and use the neutral of the No. 8 three-wire trench lay cable as a return for the lights or will I have to use a three-wire No. 12 cable for the lights which are to be controlled by the three-way switches? In other words would I need five wires or six wires to accomplish the above?"*—E.K.

A. The Code does not provide for the use of a common neutral in connection with branch circuits therefore it wil be necessary to use a three-wire cable to take care of the lights on the circuit controlled by the three-way switches.

To use the neutral of the three-wire No. 8 cable would be using a feeder neutral as a branch circuit neutral even though it has sufficient carrying capacity.

In an installation such as described above, it would be necessary to provide branch circuit cutouts in the barn in order to have a circuit for the 220 volt motor, another circuit for the 110 volt motor and a circuit for the other barn lights. Thus the three-wire No. 8 cable becomes a feeder and should be used to supply branch circuit cutouts. —F.N.M.S.

REWIRING FOR INCREASED CAPACITY

Q. *"We want to increase the capacity of a set of feeders by replacing the existing type R wires with the new type SN and had planned to have three No. 3/0 pulled into the 1½ inch pipe but the contractor approached says that No. 1/0 is the largest size conductor he can place in this pipe. Can you explain why it is not possible to use the larger sized wires?"* —M.K.

A. If the existing raceway consists of 1½ inch rigid conduit, the Code under table No. 7 would permit three No. 3/0 type SN or T in 1½ inch pipe, but undoubtedly in the instance you mention the raceway consists of 1½ inch electrical metallic tubing (thin wall) and if that is the case the contractor is correct in refusing to install conductors larger than No. 1/0. Section 3485 of the N. E. Code states that electrical metallic tubing shall not be used to contain conductors larger than No. 1/0.—G.R.

FEEDER SIZE

Q. *Please advise on the following, I have:*

1—3 hp. .220 Volt 9 phase motor rated at ..... 9 amp.
2—5 hp. .220 Volt 3 phase motor rated at ..... 30 amp.
4—7½ hp. .220 Volt 3 phase motor rated at ..... 88 amp.
1—10 hp. .220 Volt 3 phase motor rated at 28 amp.

Total .....155 amp.
Plus 25% of 10 hp. (Section 4314) ..... 7 amp.

Total .....162 amp.
Also a lighting and small power load of approximately 30 amp. which will be balanced on the phase wires and neutral ..... 30 amp.

Total Load .....192 amp.

1:—Do I figure the size of the neutral on the basis of the 30 amperes?

2:—Would it be advisable to use (or can I use) Type RH wire size No. 3/0 with a No. 6 neutral for the service?

3:—If this can be done, can I use a 200 amp. entrance switch?

4:—Referring to Art. 430 of the Code Page 154: these motors will be operating on intermittent duty, about 30 to 60 minutes duty. There will always be two motors off the line at all times. Can I use the 90 percent factor, cutting the current to approximately 173 amp.?

5:—Would it be advisable to use a No. 4 neutral in place of the No. 6?



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You'll save time and money on loudspeaker installations with the handy Operadio IMPEDANCE CALCULATOR . . . a simple twist of a disc gives you instant answers to puzzling group impedance problems! You quickly match loudspeaker lines to the amplifier for any sound system covering 500, 1000, 4000, 8000, or 16,000 ohm loudspeakers. No rule-of-thumb guesswork . . . no involved mathematical formulas. Handy 5″ diameter, fits your pocket or sales kit. Heavily varnished cardboard. Send coupon with 25¢ (not stamps) today!

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6:—If so, can I put three No. 3/0 and one No. 4 wires in a two inch conduit or can I put three No. 3/0 and one No. 6 wires in a two inch conduit?"—R.W.

A. 1:—The carrying capacity of the neutral wire is figured from the maximum possible unbalanced load on the neutral, which in this case is 30 amp. A No. 8 Type R wire or a No. 10 Type RH wire has sufficient carrying capacity for such a load but the No. 6 wire is recommended if there is any appreciable length to the run.

2:—The 192 amp. is used to determine the size of the feeders (Section 4315) and indicates that 300,000 Cm Type R wires or No. 3/0 Type RH wire should be used for the phase wires with the neutral as indicated in the preceding paragraph.

3:—The size of the entrance switch is governed (See Section 4363) by the size of the overcurrent protective device required. If time-lag devices are used, the switch as well as the protective device can have ratings of 200 amp. provided that the plant is under competent maintenance and supervision and that a sufficient supply of fuses (if fuses are used), are contiually available.

But with other than time-lag protective devices, it will be necessary to provide for starting currents. For this, there should be allowed 300 percent of the ampere rating of the largest motor or 84 amp. for the 10 hp. motor in place of the 28 amp. shown in the question above. Then 84 plus 9 plus 30 plus 88 plus 30 equals 241 amperes which would require 250 amp. fuses and likewise a 250 amp. switch.

4:—The 90 Percent factor is used for determining only the size of the conductors for the circuits to the individual motors and not for the size of a motor feeder.

5:—It is always advisable to use larger wires than the minimum size which would be permitted.

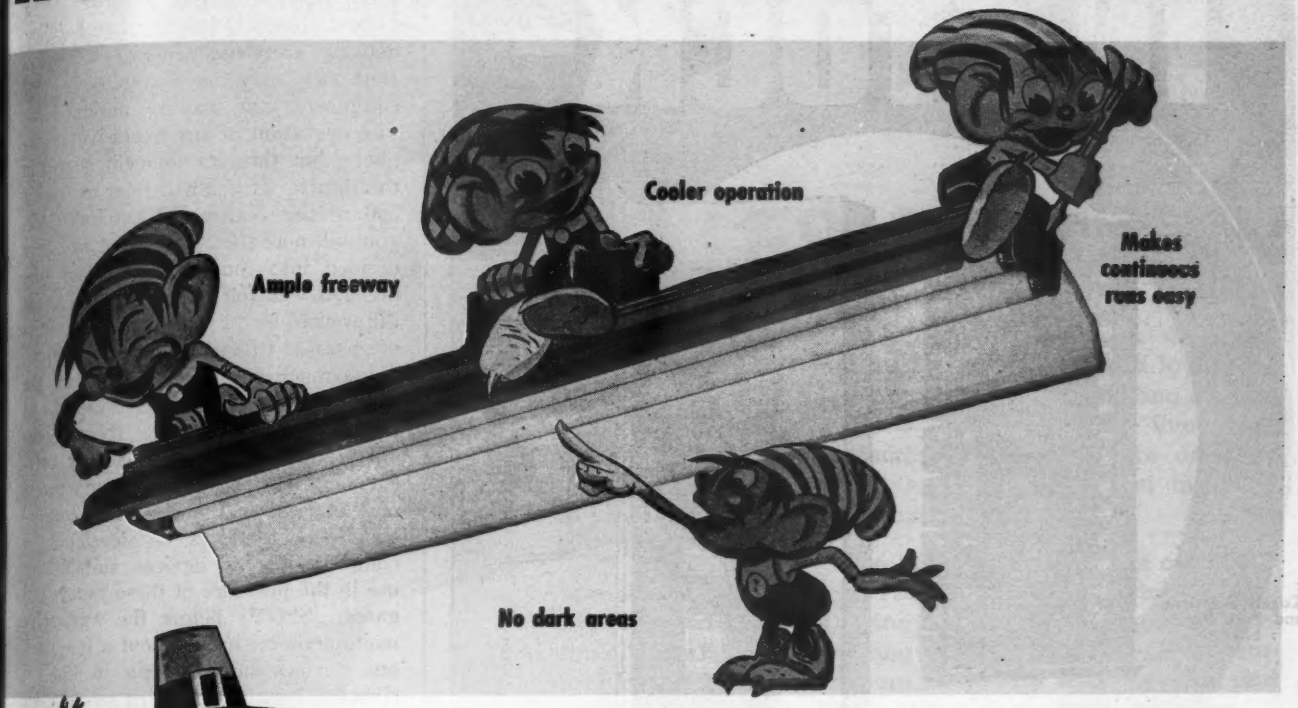
6:—Three No. 3/0 and 1 No. 4 wires require 2½ inch conduit. Three No. 3/0 and one No. 6 wires would go in 2 inch conduit.—F.N.M.S.

EXPLOSION-PROOF LIGHTING FIXTURES

Q. *"I have been asked to install an explosion-proof lighting fixture in a small detached building housing several acetylene generators and had intended to use one left over from a previous job on oil storage plant but the plant engineer claims that it would not be safe to use. The fixture has never been used and the approval label*

FOUR REASONS FOR THANKSGIVING

HOLDENLINE CHAN'L-RUN





Contractors who already sell and service HOLDENLINE CHAN'L-RUN have ample reason for thanksgiving . . . for HOLDENLINE is a friendly line—easy to sell, quick to install, simple to service and profitable to handle. For contractors who are looking for a better line to stock we suggest a study of the four sound reasons why customers, too, will be thankful to HOLDENLINE CHAN'L-RUN—

1. HOLDENLINE CHAN'L-RUN delivers high lighting efficiency—photometrically designed reflectors flood plenty of soft light just where needed to boost production—reduce errors and losses.
2. HOLDENLINE CHAN'L-RUN fluorescent equipment is quickly converted to continuous runs—using standard units wherever stepped-up lighting is desired.
3. With HOLDENLINE CHAN'L-RUN you get no lamp or socket breakage—no sagging—butt-on sockets are securely mounted on welded steel plate ends.
4. HOLDENLINE CHAN'L-RUN is the product of careful engineering—with ample freeway for wires—no dark areas between lamps.

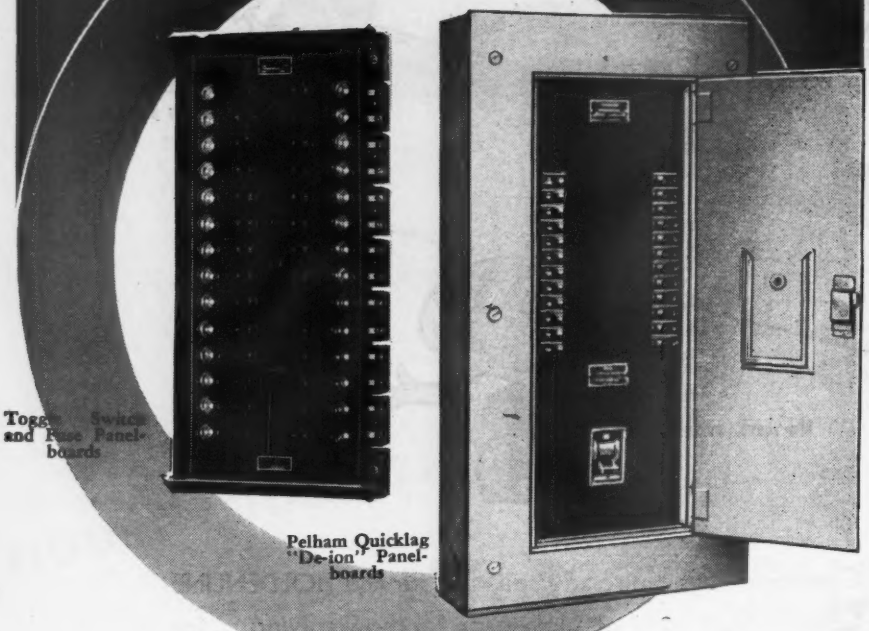
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*LIGHTING PANELS IN STOCK—



Toggle Switch and Fuse Panelboards

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All Types—Toggle Switch or Circuit Breaker—4 to 40 Circuit

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When you need quick service, you get it *without sacrifice of Pelham quality standards in any detail.*

Every Pelham Panelboard, whether standard or special, is built of highest quality materials exclusively. Skilled workmanship is backed by rigid engineering inspection. Every Pelham Panelboard is guaranteed to give completely satisfactory performance in the service for which it was designed.

We design and build all types, including Multi-breaker, Pull-fuse, Swingway, and Convertible Distribution Panelboards; narrow and column types, etc. Special switchboards and panels built to your specifications with unusual promptness.

Call your Pelham representative, or write or wire the factory.

PELHAM ELECTRIC MANUFACTURING CORP., Erie, Penna.

SPECIALIZED DESIGN **Pelham** UNEXCELLED QUALITY

• SWITCH BOARDS • PANEL BOARDS • SWITCH GEAR AND ACCESSORIES

states that it is explosion-proof. Why should such a fixture be unsafe?"—J.B.

A. The engineer was right in refusing to accept an explosion-proof lighting fixture approved for a Class I Group D location in a building housing acetylene generators. Sometime we may have explosion-proof equipment that may be designed for safe operation in any explosive atmosphere, but this development is still in the future. If you will refer to Article 500 of the National Electrical Code, you will note that Class I locations are divided into four groups. The subdivision was felt necessary due to the difference in physical characteristics of gases and flammable liquid vapors.

Inasmuch as Group D contains the most commonly encountered vapors and gases, such as many petroleum products, alcohols, acetone, lacquer solvents and natural gas, the manufacturers of electrical equipment have concentrated their efforts on developing a complete line of devices suitable for use in the presence of these vapors and gases. Shortly before the war, some manufacturers brought out a few various devices safe for use in Class I Group C locations and just recently one concern received the Underwriters Laboratories approval on a Class I Group A lighting fixture. An atmosphere containing acetylene gas is considered a Group A location; therefore at the time this answer is being written there is only one manufacturer of lighting fixtures which can be considered safe in the presence of acetylene gas. Previously these generator rooms or buildings have been illuminated by floodlights so mounted on the outside that light would be directed through windows or skylights.—G. R.

GROUNDING CONDUCTOR

Q. *"Is it true that a No. 8 grounding conductor can be run along the surface without being enclosed in conduit thin wall or cable armor?"—* G.M.B.

A. Yes, if not subject to mechanical injury. This provision will be found in interim amendment No. 81 to Section 2592 and was approved on February 10, 1943.—G.R.

N.E. CODE BOOKS

Q. *"In* ELECTRICAL CONTRACTING *for June you answered some questions and I am asking you to send*

has

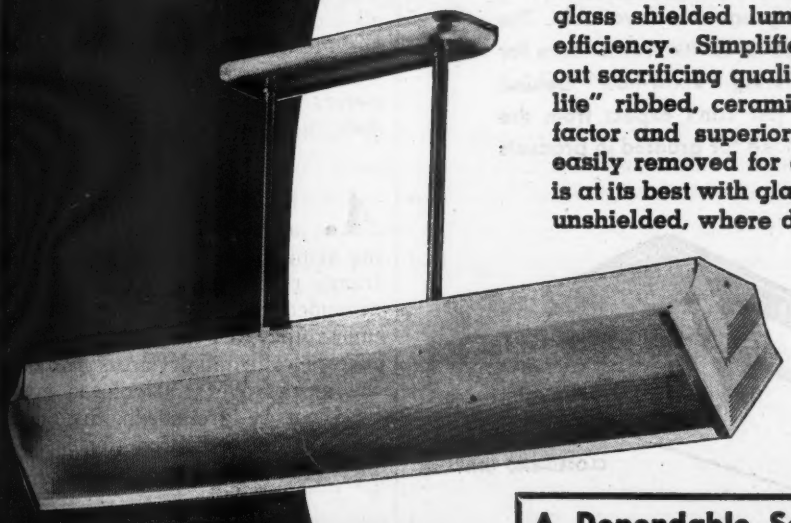
SALES APPEAL!



In commercial lighting, attractiveness, high efficiency and low maintenance are the outstanding requirements. The two Spero fluorescent luminaires illustrated are designed and engineered to meet these requirements.

The SPERO LVR Line has aply been termed "Masterpiece of Fluorescent Engineering". Light from the four 40W Reflecting surfaces are designed to eliminate trapped light—resulting in high intensity with low surface brightness. Louvres are hinged for easy cleaning and servicing of lamps. Plastic side pieces shield end tubes.

The SPERO CVG Line meets the demand for a low-cost, glass shielded luminaire of smart appearance and high efficiency. Simplified design makes low price possible without sacrificing quality. Panels of specially selected "Claralite" ribbed, ceramic coated glass have 80% transmission factor and superior diffusing qualities. Glass panels are easily removed for cleaning and maintenance. While unit is at its best with glass panels, it is designed for effective use unshielded, where desired.



Both these fixtures are available with SPERO INSTA-LITE, providing instantaneous starting and eliminating starters. Write for descriptive bulletins.

See Spero's Revolutionary Fluorescent Developments at The Victory Lighting Jubilee 17th Regiment Armory New York City Nov. 26 to 30, Inc.

A Dependable Source for Electrical Products

In addition to its complete lines of industrial, commercial and residential fluorescent fixtures, Spero offers reflectors, flood lights, yard lights, vapor-proof units, cargo lights, weatherproof diecast sockets, surface cabinets, switchplates, outlet boxes and other installation equipment. All Spero products are sold only through legitimate electrical wholesalers.

THE SPERO ELECTRIC CORPORATION

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BEWARE OF

"DOUBTFUL ORIGIN!"



There are mongrels in lighting products, too! You know the kind—a bit of light-gauge metal, haphazardly bent to shape . . . probably bootleg wiring parts . . . a slip-shod paint job.

Now that our war contracts are a closed book . . . now that you can once again obtain SILV-A-KING fixtures . . . why even consider these mongrels of the lighting industry? The metal that goes into SILV-A-KING products is the best heavy-gauge steel available. The lifetime porcelain-enamel finish on SILV-A-KING fixtures is there for keeps. The engineering and manufacturing "know-how" behind SILV-A-KING fixtures is something you just can't expect from the "tin-knocking" crowd . . . something you take for granted in products that bear the SILV-A-KING label.

SILV-A-KING "SPECIFICATION"
Lifetime porcelain fluorescent unit



BULLETIN 45 FS—YOURS FOR THE ASKING!

BRIGHT LIGHT REFLECTOR CO. INC.
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SILV-A-KING LIGHTING EQUIPMENT
SINCE 1931

me a little information such as where and how can I get a book containing the N.E. Code? I am interested in wiring new or remodeled buildings and I do want the right answers as our Inspector in this district is on the beam, so please rush this information if you can."—G.A.F.

A. The National Electrical Code is published by the National Board of Fire Underwriters, 85 John Street, New York, 222 West Adams Street, Chicago, Ill., or Merchants Exchange Building, San Francisco, Cal. There is no charge for single copies.

Of course no one should attempt to install any electrical wiring without having had the necessary instruction and study and without having acquired a practical knowledge of the National Code. It requires considerable study and experience to really understand the Code's requirements. —F.N.M.S.

REWIRING A PAPER MILL

Q. *"I am revamping some of the wiring in a paper mill and an argument has developed regarding the need for grounding motors. I attempted to obtain permission to ground all motor frames in the mill proper, but the engineer disagrees with me saying that it is not necessary to ground motors operating at 220 volts. What does the Code require?"*—M.F.

A. Most paper mills have certain areas that are subject to varying amounts of moisture and all motor frames regardless of voltage should be grounded when subjected to moisture unless they are isolated or guarded. Motors located in dry areas and operating at not over 150 volts to ground need not be grounded. See Section 4436 of the N. E. Code for these rulings.—G.R.

OUTDOOR LIGHTING

Q. *"Is it really necessary to use stranded wire for outdoor lighting when molded sockets are used which have terminal pins that are forced through the insulation to make contact with the conductors?"*—G.F.

A. Yes, the N. E. Code under Section 7347 contains a very definite ruling which reads as follows: "If lampholders have terminals of a type which puncture the insulation and make contact with the conductors, they shall be attached only to conductors of the stranded type."—G.R.



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RCA SOUND SYSTEMS

RCA SOUND EQUIPMENT



Control console—contains radio, phonograph and microphone inputs, control and selector switches.



Speakers—wall-cabinet and flush-mounted types for inside use; horn-baffle type for outdoor use.



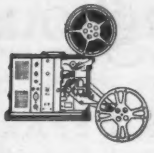
Microphones—dynamic and velocity types, in either table or floor-stand mountings.



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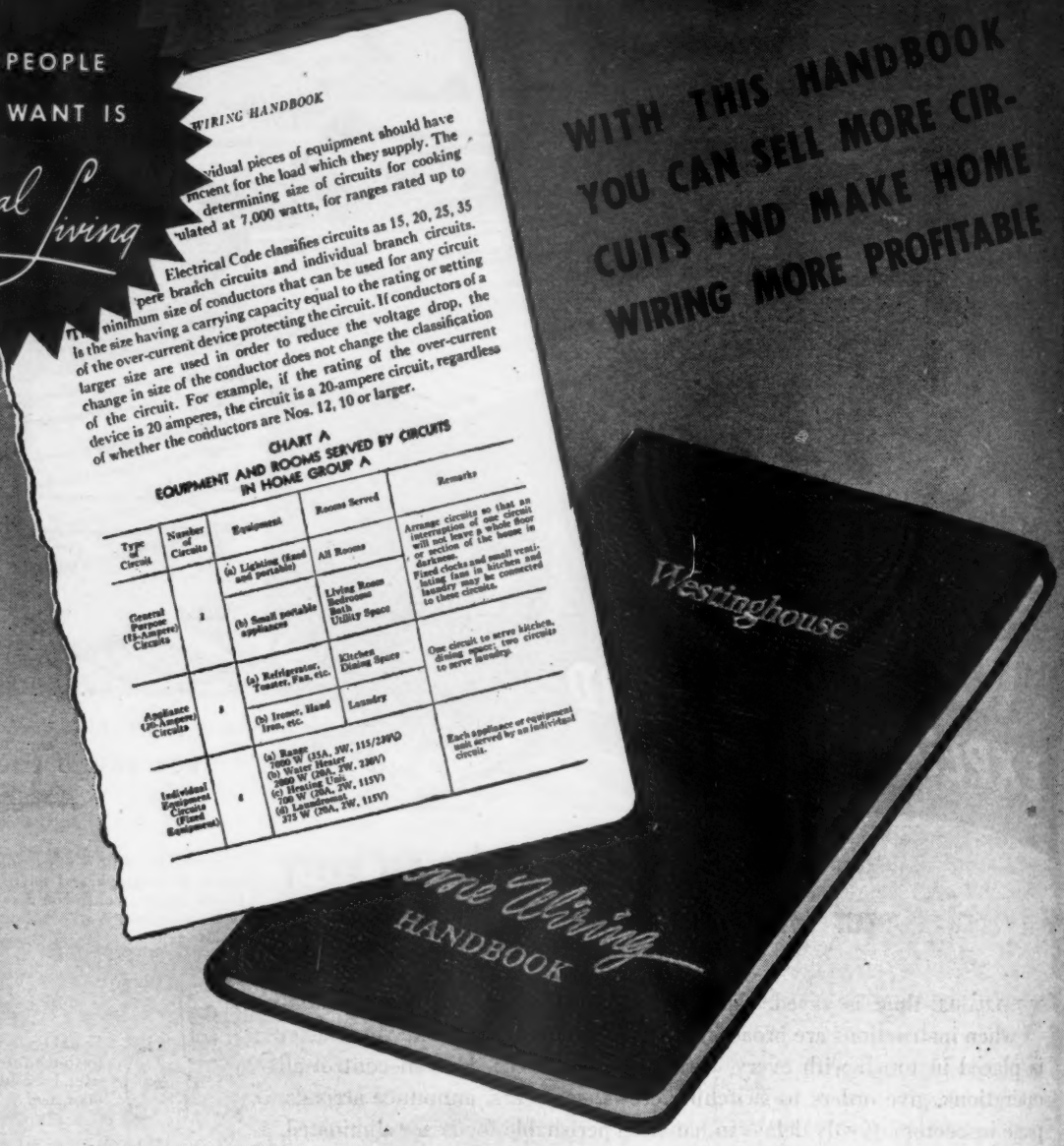
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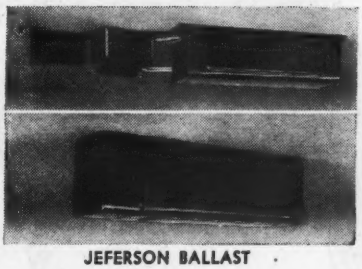
Street.....

City..... State.....

THESE ANNOUNCEMENTS of new equipment are necessarily brief—for more detailed description, sizes, prices and other data write to the manufacturers' advertising departments, tell them in what issue of ELECTRICAL CONTRACTING you saw the item and they will send full details to you.

EQUIPMENT NEWS

Cold Cathode Ballast

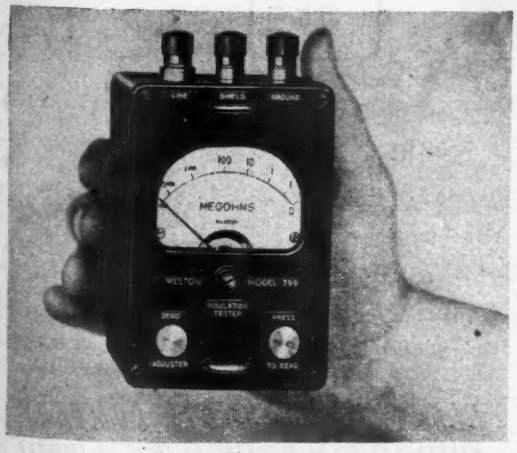


JEFERSON BALLAST

To fit this line of cold cathode ballasts, a junction box which can be attached with the bolts used for mounting the standard ballast has been developed. The box is made in two pieces. One piece is designed to slide over guides on one end of the ballast case while the other forms the cover which is secured by one screw. Suitable knockouts are provided in sides, ends and bottom. Thus the standard ballasts requiring no junction box as in the case of fixture installation, also serve where boxes are required. Jefferson Electric Company, Bellwood, Ill.

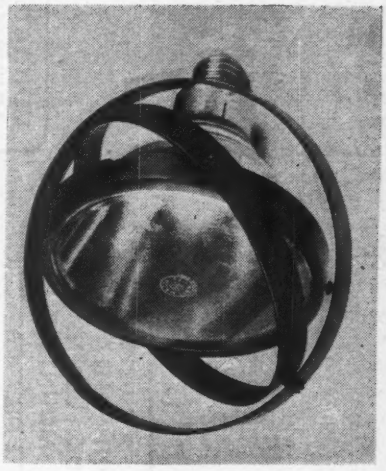
Insulation Tester

This direct-reading insulation measuring device is for applications where high testing potentials are not desired. Known as Model 799, it provides a single range for readings from 0.1 megohms to 10,000 megohms; with the 10,000 mark at eight percent of the scale length. The circuit has a test potential of less than 50 volts d-c. An electrical guard circuit is provided for elimination of surface leakages when testing cables. In electrical testing it replaces specially built test stands, for checking leakage between windings in transformers, cable resistance, leakage of low voltage paper and mica condensers without damaging the dielectric, and for numerous other tests. The size of instrument is 5⅜ by 3¼ by 4⅞ inches. Weston Electrical Instrument Corporation, 617 Frelinghuysen Avenue, Newark 5, N. J.



WESTON TESTER

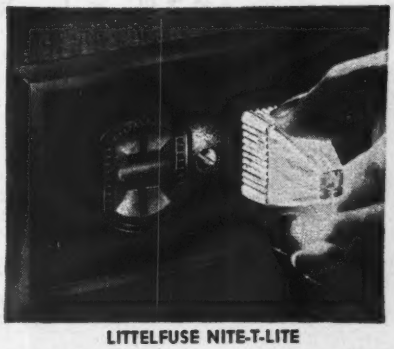
Spotlight Mounting



G-E SPOTLIGHT MOUNTING

A new method of mounting filament spotlights in fluorescent fixtures has been announced. It uses the principle of the ship's compass ginibal ring, and provides a simple means of focusing and adjusting the spotlight beam through a wide angle over the display area. It can also be used in recessed individual wall or ceiling pockets. The lamp is held in three concentric rings, ⅝-in. deep and 4⅞-in., 5⅛-in. and 6-in. in diameter. The outside ring is mounted in fixture with thumb screws or bayonet locking device to permit easy removal. The inner ring supports the lamp and has two round bearing pins 180° apart which fit into the intermediate ring. The intermediate ring also has similarly placed bearing pins that fit into the outer ring. These pins are located in the outer ring 90° from the inner ring bearing which provides a two way adjustment for aiming the lamp. General Electric Company, Nela Park, Cleveland, Ohio.

Lighting Device



LITTELFUSE NITE-T-LITE

This lighting device, known as Nite-T-Lite, can be placed throughout the house to burn all night. It fits into any wall plug or any electrical outlet and casts a subdued, rosy glow. It illuminates "danger" points; and indicates the location of lamps or electric light buttons. It is especially useful in bedrooms, baths, nurseries, halls, kitchens and stairways. It can be operated continuously for less than a cent a month. Littelfuse Incorporated, 4757 N. Ravenswood Avenue, Chicago.

Allbright

TELEPHONE, JUNIPER 6022

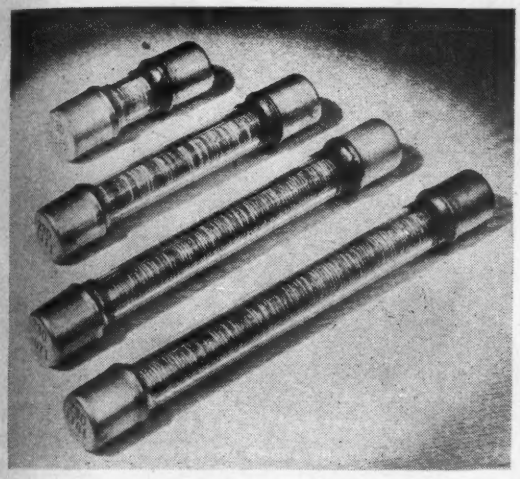
ELECTRIC PRODUCTS COMPANY

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Selenium Rectifiers

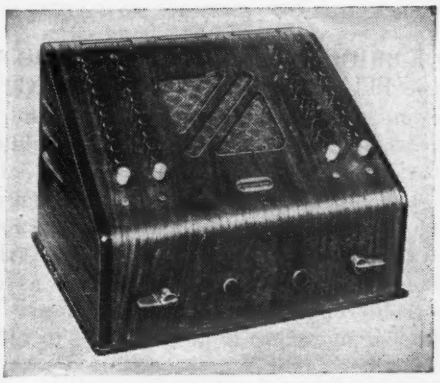
High-voltage selenium rectifier stacks, hermetically sealed in glass, have been developed. Constructed like a cartridge fuse, the stocks may be installed quickly and easily. Electrical connection is made through silver plated ferrules at each end of the glass tube. These ferrules permit mounting in 30 ampere fuse clips unpolarized or polarized by addition of a simple member to the fuse clip assembly. Especially designed for operation in high ambient temperatures, the rectifiers are available in several tube lengths and in various voltages up to 4000 volts. Federal Telephone and Radio Corporation, 67 Broad Street, New York 4, N. Y.



FEDERAL RECTIFIERS

Paging and Intercommunication System

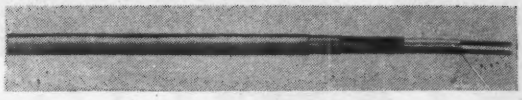
This self-contained, desk console communication system is designed for two way talk, paging or soundcasting. The system permits master to master or master to remote operation with any number of stations up to 40. Pushbutton station selection is provided and a master key allows blanket calls to all stations. The master unit delivers 15 watts, is housed in a walnut cabinet with pilot light, power switch, amplifier and loud speaker-microphone self-contained. Remote stations are available in several types for office, factory or outdoor installation. Power supply is 60 cycle. David Bogen Company, 663 Broadway, New York 12, N. Y.



BOGEN INTERCOMMUNICATION SYSTEM

Small Diameter Cable

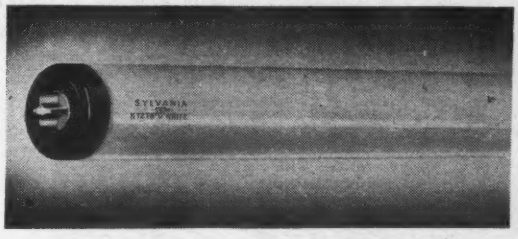
A new small diameter non-metallic sheathed cable with thermo plastic insulated Type T conductors has been announced. It is known as "PVX" and is made in two and three conductor assemblies in sizes 14 to 4 without ground wire. The thermo plastic insulation used on these conductors is claimed to have long life, high in dielectric and mechanical strength, flame retarding and resistant to oils, acids and alkalies. It is approved by the Underwriters' for 60 deg. C operation. PVX cable assembly consists of the thermo plastic insulated conductors, a spiral wrapped impregnated crushed paper armor, waterproof jute fillers, a longitudinal paper wrap and a moisture-resisting, flame-retarding over-all braid. The small diameter requires less space in outlet boxes. General Electric Co., Bridgeport 2, Conn.



G-E CABLE

Cold Cathode Lamp

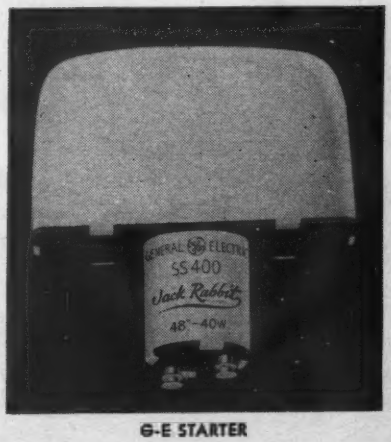
Addition of a cold-cathode K lamp to the regular line of fluorescent products has been announced. The new lamp will be made in both 72 inch and 96 inch lengths of T8 (1 inch) diameter. It will be instant starting and operate on a standard 120 milliampere multiple ballast. On and off operation will have no influence on reducing the life of the lamp, it is claimed. The base of the K lamp employs a special contact pin which fits into a lampholder punched with a hole of similar design. The variation in the design of the base was made in order to prevent the LS type fluorescent lamp from being inserted in a circuit designed for the K lamp, or cold-cathode type of ballast, as the two lamps have different starting and operating characteristics. The new lamp is especially adaptable for installations where maintenance is either difficult or costly. Sylvania Electric Products, Inc., Salem, Mass.



SYLVANIA K LAMP

Starter for Fluorescent Lamps

This new split-second starter for fluorescent lamps is called the "Jack Rabbit". Designed to fit in conventional starter sockets, it should be used with instant starting lamps. It is larger than standard starters, measuring about 2¾ inches long, 2½ inches deep and 1 inch wide. When used with standard sockets, these devices should be located in the fixtures to provide clearance for the starter. It can also be used for replacement in existing fixtures that have the proper clearance for the starter's dimensions. General Electric Company, Bridgeport 2, Conn.

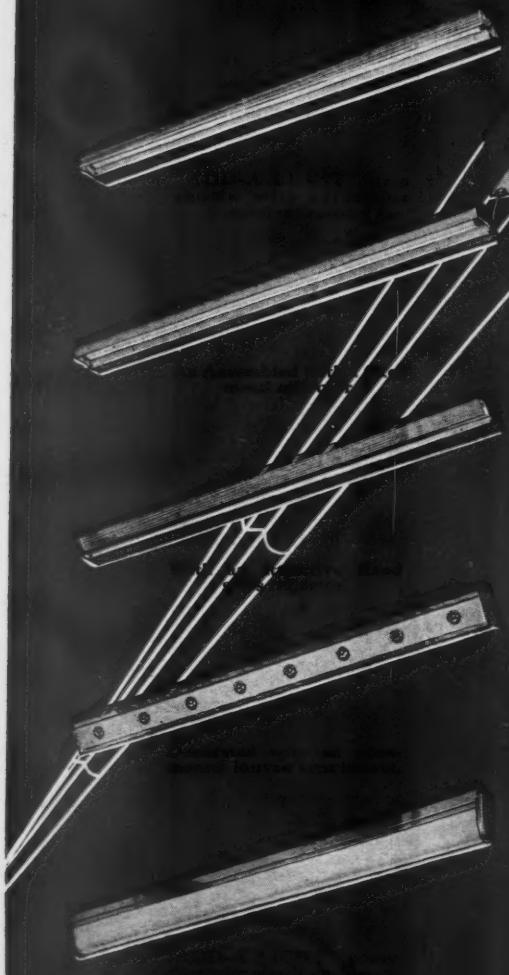


G-E STARTER

Announcing "ADD-A-LIGHT"



The "ADD-A-LIGHT" Strip... which in addition to being a complete fluorescent lighting unit within itself... is the basis for all adaptations shown in left column. Once a single unit is connected... additional units may be extended any distance required (see male and female plugs above). Basic strips and attachments come in 24, 48, and 96 inch lengths.

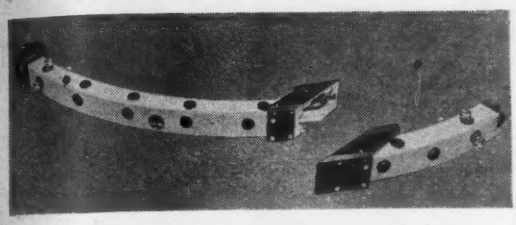


● MOE-BRIDGES is proud to present "ADD-A-LIGHT" an entirely new type FLUORESCENT LIGHTING UNIT. "ADD-A-LIGHT" is a new conception in fluorescent lighting, not an old fixture with a new dress. It is a new "package lighting" line... and opens up a new market in lighting equipment sales to commercial institutions, homes and offices. "ADD-A-LIGHT" is equally as effective and efficient for complete new installations... the replacement market... or as a supplement to existing equipment. "ADD-A-LIGHT" can be merchandised in the same simple manner as toasters, coffee makers and all other portable electric appliances. "ADD-A-LIGHT" can be installed anywhere without regard to electrical outlet... and can be either pinned-up on picture hooks or permanently and quickly mounted using wood screws with bayonet lock-up mounting holes. You must see "ADD-A-LIGHT" to appreciate its complete simplicity and marketing possibilities. JOBBERS are requested to write for full information and to place their quantity commitments as soon as possible. DEALERS will find "ADD-A-LIGHT" a real addition to their package merchandise counter, and are invited to contact their Jobber immediately.

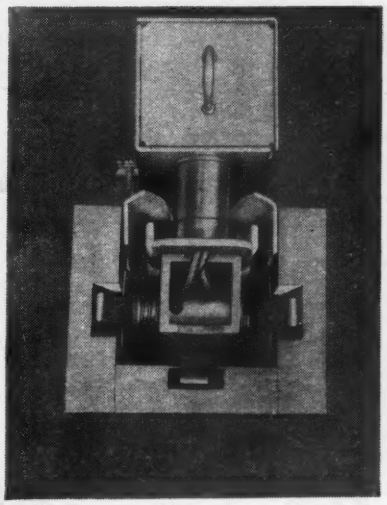
MOE-BRIDGES Corp.

SHEBOYGAN, WISCONSIN

Trol-E-Duct



CURVED SECTION



CROSS SECTION

A modification in the duct design and a new transfer-type trolley for crane and hoist switching and transfer has been announced. The claim is made that these provide a safe and more efficient means for transferring loads mechanically and electrically from crane bays to individual factory areas; monorail transfer and switching is also made easier and more flexible. This is accomplished by electrical transfer trolleys with swiveled heads moving through duct runs having flared ends to facilitate juncture with and transfer to similar runs in adjacent factory bays. Straight or curved runs of electrical Trol-E-Duct are attached to and move with the crane and hoist equipment. BullDog Electric Products Company, 7610 Jos. Campau Avenue, Detroit, Mich.

"Watch Dog" Starter

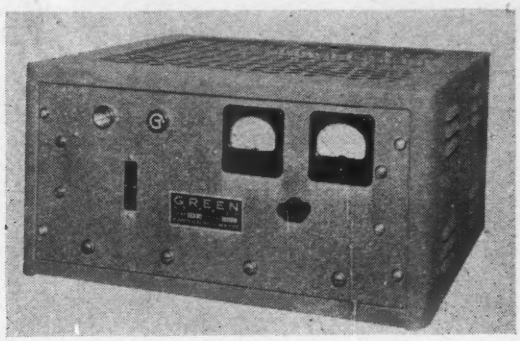
This new "Watch Dog" starter for 15 and 20 watt fluorescent lamps is suitable for commercial and residential lighting fixtures. Two features of unit are precision lamp starting and dead lamp lockout. When a dead lamp is removed, the "Watch Dog" is reset by pressing a button on top of the starter. The new lamp is then inserted, and the "Watch Dog" brings it into the circuit. Its mechanical features help to conserve the life of the lamp, life of the ballast, power consumption and maintenance service. General Electric Company, Bridgeport 2, Conn.



G-E STARTER

Rectifier

In this new series of "TRX" stabilized rectifier units, the dynamic voltage regulation characteristic is such that the load current may be varied between zero and maximum at any demand frequency, with negligible variation in terminal voltage. The new circuit compensates also for normal variations in a-c supply voltage to the rectifier unit. Other features include non-resonant filter; optional connection to 115 or 230 volt 50/60 cycle a-c supply; optional output ranges, 110-120, 150-160 volts; circuit breaker switch protection on a-c side; voltmeter, ammeter and supervising lamps; construction for mounting in standard 19 inch panel cabinets; and models for 1, 2, 4 and 7 ampere capacity. W. Green Electric Co., Inc., 130 Cedar Street, New York, N. Y.



GREEN RECTIFIER



SYLVANIA CIRCULAR LAMP

Circular Fluorescent Lamps

Circular fluorescent lamps supplied with translucent rotating bases have been announced. Suitable for ceiling fixtures, table and other portable lamps in home and commercial applications. Translucent plastic bases permit turning the lamp a full 180 degree without removing it from lamp holders. By reversing position of the lamp it may be turned another 180 degrees, thus making possible a total of 360 degrees around the lamp holder. Translucent plastic bases also pick up light from the lamp and tend to eliminate dark spots in a continuous ring of light. A typical lamp has an outside diameter of 12 inches, is rated at 32 watts. Two or more lamps of different diameters may be mounted together to provide concentric rings of light from compact fixtures. These lamps operate with conventional fluorescent lamps ballasts provided with manual or automatic starter control. Sylvania Electric Products Inc., Salem, Mass.



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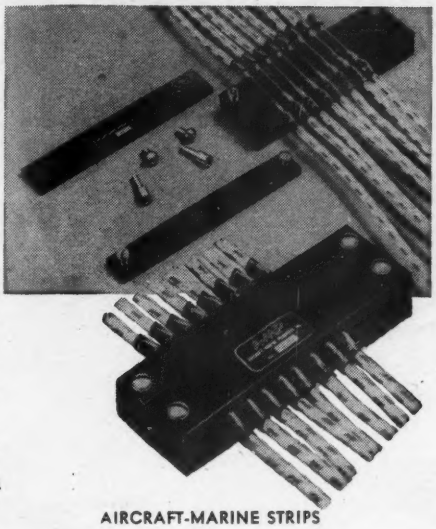
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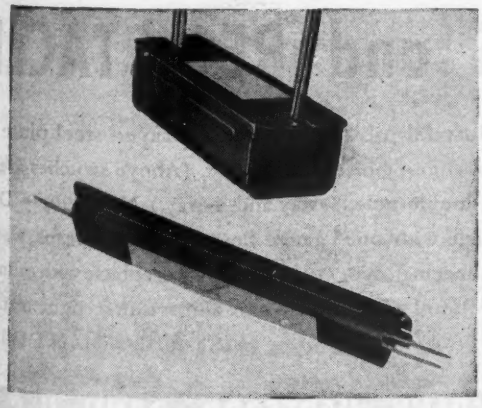


AIRCRAFT-MARINE STRIPS

These new connector strips incorporate the knife switch disconnect terminal design. The permanent disconnect member of the splice has an extended tongue which fits into the connector strip. This member terminates in a knife switch stamping to which any terminal of the knife switch design may be connected or disconnected by holding the free terminal end vertically in contact with the strip member and then pulling back. Two types are available—(1) the single width strip adapted to use with the AMP pre-insulated splicing terminal which requires no insulation sleeving. (2) The double width strip in which the disconnect ends are enclosed, locked and insulated by the cover, one-half of which is independent of the other half. Special stacking screws with threaded leads make it possible to permanently stack a series of AMP strips with the cover screwed on top. The strips may be specified to accommodate any desired number of connections. Aircraft-Marine Products, Inc., 1593S North Fourth Street, Harrisburg, Pa.

Ballasts

Two new special ballasts have been announced. One is a single-lamp type, designed for the operation of a new line of 13 watts Mazda F lamps used primarily in show cases and other similar installations. The other, available in either single-lamp or Tulamp models, is for the instant-starting operation of the new line of Slimline Mazda F lamps designed for decorative and other special lighting purposes. The type for the 13 watt lamps have been designed for use on 118 volt, 60 cycle circuits and are equipped with a step up autotransformer providing the necessary 200 volts to facilitate lamp starting. Available in either uncorrected or high power factor ratings. The styles for the Slimline lamps can be obtained for operation at 100 or 200 milliamperes. They are of the high voltage type and do not require separate starting equipment. Both styles are housed in two way lead cases allowing the leads to be brought out either the end or the bottom and permitting greater flexibility of installation. General Electric Company, Schenectady 5, N. Y.



G-E BALLAST

Hydraulic Earth Boring Machine



JAQUES BORING MACHINE

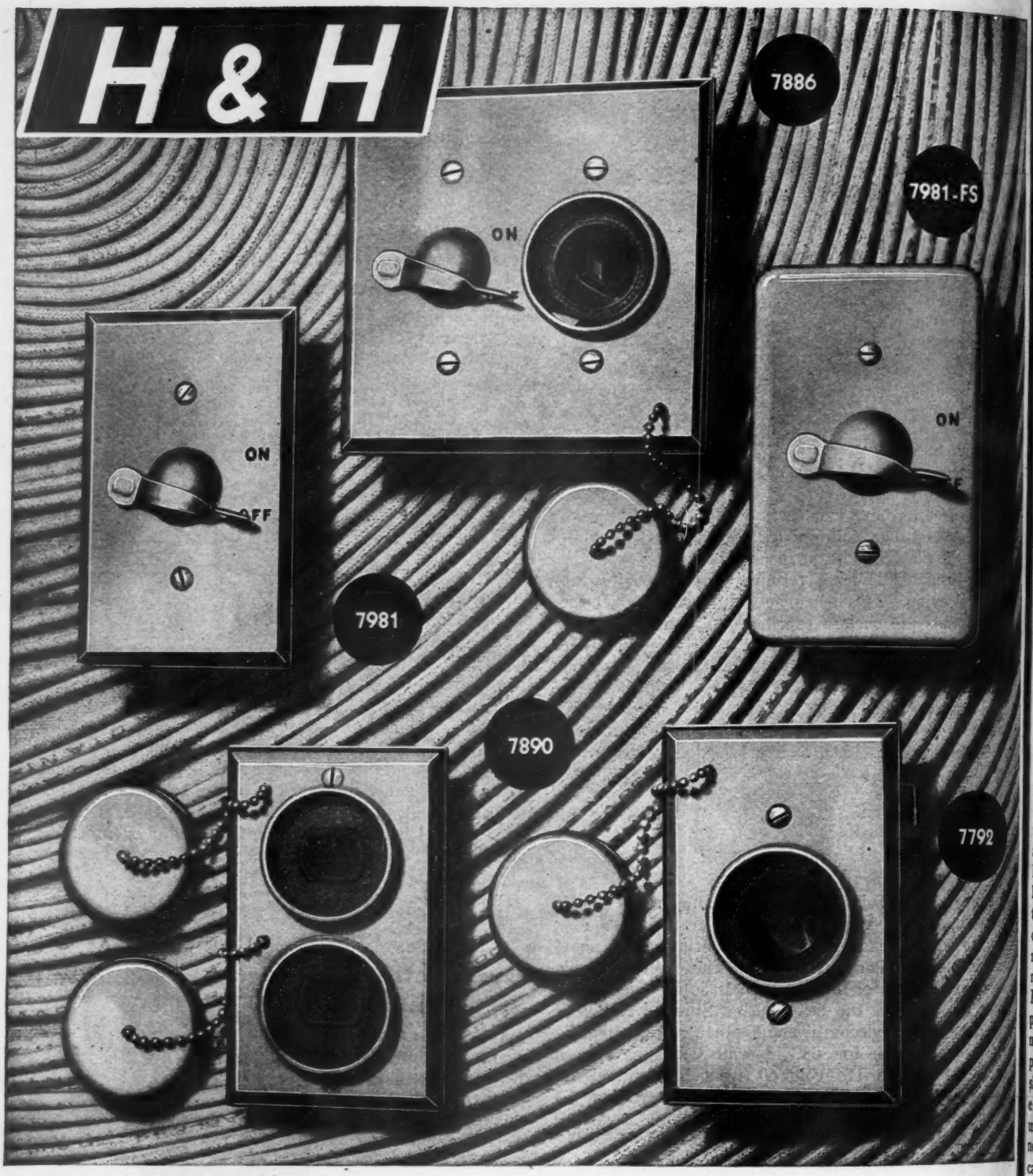
This new hydraulic earth boring machine is self-contained and driven by a separate gasoline motor. The whole machine is mounted on a sturdy steel under-frame. It can be mounted on a 1½ ton or larger truck or trailer and be removed when truck is needed for other work. Anchor holes up to 45 degrees angle with the horizon may be bored. All controls are within reach of the operator. The plumbing and vertical motion of the bit is controlled by means of hydraulic pressure. The hydraulic feed automatically regulates the speed of drilling to suit the texture of the soil. It carries any size bit up to 24 inches in diameter and can bore to a depth of eight or nine feet. The Jaques Power Saw Company, Denison, Texas.

Photoelectric System



PHOTOSWITCH CONTROL

This photoelectric system detects smoke in air conditioning ducts and sounds alarms, turns off blowers, operates automatic dampers, or provides whatever other types of indication or control is required. It consists of photoelectric control Type A26X and light source type L11RX. Both units are available either in explosion-proof housings for mounting in Class 1 Group D hazard areas, or in weather-proof steel housings. Type A26X operates from 115 volts a-c 60 cycles and incorporates a single-pole double-throw relay for normally open or normally closed operation. Relay contacts are designed to handle 10 amperes a-c or 5 amperes d-c at 115 volts. Photoswitch Incorporated, 77 Broadway, Cambridge, 42, Mass.



WEATHERPROOF SWITCHES and RECEPTACLES

Designed for outdoor applications—from porches and patios to factory platforms—*and* industrial inside installations subject to excessive moisture. No. 7886, — 2-gang unit, single-pole Switch and Receptacle, with cadmium-finished brass plate fitting over weather-tight rubber mat. No. 7981,— Single-pole Switch with cadmium-finished brass plate and weather-tight rubber mat. No. 7981-FS,—Switch for use with "FS"-type fittings for industrial jobs. Aluminum-sprayed steel plate with rounded edges; moisture-tight mat. (Above switches available also in double-pole, 3-way and 4-way.) No. 7890, — Duplex Receptacle with .060" gauge brass plate, metal caps, weather-tight rubber mat. No. 7792,—Single Receptacle with cadmium-finished brass plate, metal cap and weather-tight mat. *Sold through Electrical Wholesalers.* HART & HEGEMAN DIVISION

THE ARROW-HART & HEGEMAN ELECTRIC COMPANY, HARTFORD, CONN., U. S. A.

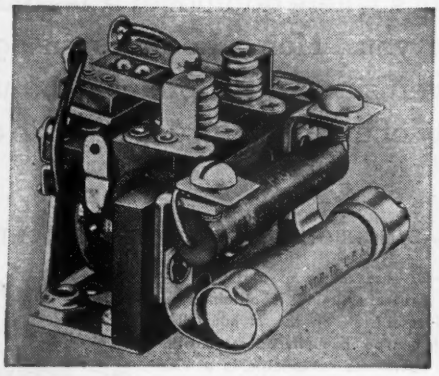
Semi-Silvered Bowl Lamps



G-E SEMI-SILVERED BOWL LAMP

Two new silvered bowl lamps with a circular inside frosted "window" at each bulb's end has been announced. Rated at 300 and 500 watts respectively, the new semi-silvered bowl lamps are otherwise identical with present G-E silvered bowl types of the same wattage. Each is semi-silvered, inside frosted, and has a mogul screw base. The down light filters through a 2¾ inch diameter inside frosted window of the 300 watt semi-silvered unit. Diameter of the circular window of the 500 watt is three inches. General Electric Lamp Department, Nela Park, Cleveland, Ohio.

Self Timing Interrupter

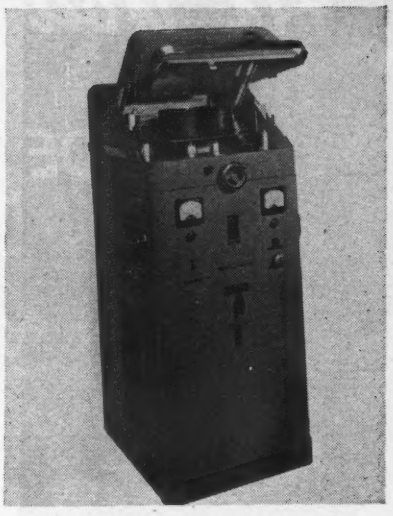


ELECTRONIC INTERRUPTER

This new flasher - interrupter comprises a miniature but heavy duty relay, an electro-thermal timing device and a non - inductive resistor unit. Four studs are provided for mounting on panel, bracket, shelf, etc. with elastic stop units. It is normally furnished in open design but any required enclosure can be supplied including hermetically sealed or pressurized types. Interruptions can be controlled through a range of from 60 to 80 per minute by varying the current through the thermal unit. Operating voltages include all standard a-c and d-c ranges and frequencies. Electronic Testing Laboratories, 44 Summer Avenue, Newark 4, N. J.

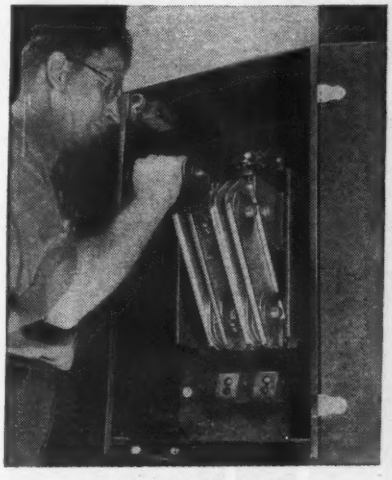
Dielectric Heater

A new Thermatron dielectric heater, known as "Heatmaster", applicable for plastics, dehydration and sterilization has been announced. It is particularly designed for heavy-duty preheating in the plastic molding industry. Completely self-contained, the unit incorporates a built-in electrode cage, automatic protection, heavy electrodes and radial-fin air cooled tubes. Other features are safety interlocks, industrial type pushbuttons, overload relays and circuit breaker, connecting terminals, fully calibrated dials. Output is 5 kw. plus; input 8 kva., line voltage 220 volt, 60 cycle, 3 phase. Thermatron Division, Radio Receptor Co., Inc., 251 West 19th St., New York 11, N. Y.



RADIO RECEPTOR HEATMASTER

Disconnect Switch



ALLIS-CHALMERS SWITCH

A new high current capacity "MC" disconnect switch has been developed for installations where sections of heavy current capacity a-c and d-c circuits must be isolated. High contact pressure in the closed position and ease of operating large multi-pole assemblies are provided by a mechanism which releases spring pressure on contact surfaces during opening and closing of switch. Pressure on each stud contact is individually adjustable, so that each parallel blade member carries its share of the total current, and visible compression of the spring washers indicates the actual existence of contact pressure. Switch blades can be locked at any angle in the open position by tripping a special latch which permits clamping hinge contacts under full spring measure. Hand or hook-stick operated, this switch is available in sizes from 4000 to 10,000 amperes at 750 volts d-c maximum, and has a range of 3000 to 6000 amperes in a-c applications. Allis-Chalmers Mfg. Co., Milwaukee, Wis.

Germicidal Lamps

Two types of germicidal lamps are available in 15 and 30 watt T-8 sizes. Type A is suitable for school rooms, homes, dairy barns, poultry houses, hospitals, lavatories, and thersterilization of drinking glasses. Type B is suitable for meat storage refrigerators, air conditioning ducts, food packaging; canning, bottle and jar filling operations. Indirect systems of radiation produce best results when aluminum or polished chrome reflectors are used to shield the lamps from the eye and to reflect ultraviolet rays upward. Fixtures may be suspended from the ceiling or mounted on the walls in an indirect cove section in any position. Sylvania Electric Products Inc., Salem, Mass.

As You Light the Way . . .

INCLUDE AUTOMATIC CONTROL

Sangamo

TIME SWITCHES



ASTRONOMIC DIALS

Efficient control of window lights, bill-boards, and street lighting can be best accomplished by use of a Sangamo Time-Switch equipped with an Astronomic Dial. This, allows "on" and "off" operations to accurately follow sunset and sunrise time.

☆

A lighting installation . . . and then what? Well, for one very important consideration, how about those "on and off" times? For convenience sake there should be *automatic* control — and that's exactly where SANGAMO TIME SWITCHES are decidedly important—that's where additional sales and installations begin for you. Men who invest in lighting for utility, for advertising, or for protection, quickly see the advisability of this modern, dependable *automatic* control.

FORM KAZ—SYNCHRONOUS MOTOR—SILVER CONTACTS

Six levers are provided for a maximum of 3 daily "on" and "off" operations. Accurate timing is obtained by turning the minute hand reset staff on the 24 hour dial. If desired the time-switch can be manually operated without affecting subsequent operations. Available in a wide variety of combinations providing two-circuits, duplex, and outdoor switches; also with Sunday and holiday om'tting device, as well as advance time cutoff. The KAZ Astronomic Dial Time-Switch functions to close the circuit at sunsunset and open it at sunrise, or the "off" operation may be set at any time between 9:30 P. M. and 2:15 A. M.



FORM KAZ



FORM VSW

FORM VSW—SYNCHRONOUS MOTOR —WITH CARRYOVER

Synchronous timing is combined with reserve spring clock operation, providing continuous operation during current interruptions up to ten hours. This entirely automatic carryover eliminates the necessity of resetting the dial after current interruptions, and insures accurate timing under all conditions. Also equipped with Astronomic Dial.

SANGAMO ELECTRIC COMPANY SPRINGFIELD ILLINOIS

IN THE NEWS

MIDWEST INSPECTORS PREVIEW NEW CODE

Following the adjournment of the code making Electrical Committee by just two days, the Forty-First Annual Meeting of the Western Section, International Association of Electrical Inspectors held in Chicago's LaSalle Hotel, Oct. 15–16, presented an ideal opportunity to secure a preview glimpse of what the new 1946 National Electric Code would include. Approximately 300 members and guests attended the sessions which originally were planned on a limited basis because of the then existing travel restrictions.

A major portion of the two-day meeting was devoted to a review and discussion of the new code rules. Victor H. Tousley, electrical field engineer, NFPA, and secretary-treasurer of the IAEI, presented a brief outline of the salient changes in the new code. The following high-lights are of interest to contractors and inspectors:

Article 210—Branch Circuits—The 25 and 35-ampere branch circuit will be deleted. New code recognizes 50, 30, 20, and 15-ampere circuits. The recommendation to include a positive statement requiring power factor correction was rejected. A note will appear, however, advising that lighting loads with transformers or ballasts *must be computed on the basis of amperes* and not watts.

The rule on color coding will be reinstated. There will be no reduction in size of neutral on range circuits. Range cable with 2-No. 8 and 1-No. 10 wires accepted if cable is so marked.

Laundry receptacle *must be 3-pole grounded.*

Section on common neutral was deleted.

Industrial lighting fixtures with other than screw-shell lampholders, mounted more than eight feet from the floor, and equipped with a switch as an integral part of the fixture, will be permitted on branch circuits of not over 300 volts to ground.

Article 230—Services — Changes made covering high voltage services.

Article 240—Overcurrent Protection—Thermal type breakers will be rated at circuit ampere capacity; instantaneous type at 125 percent circuit amperes.

One trip coil will be required on each ungrounded feeder wire (three coils on three-phase breakers). This will not apply to motor controllers.

Type S fuses effective with next code. A 20-amp. circuit breaker is not recognized as a Type S fuse.

Article 250—Grounding—will be much the same as in 1940 code. Minority report on this was withdrawn by submitters at beginning of Electrical Committee meeting. Sections 2523 and 2524 were adopted as recommended by the article committee.

The grounding of range frames on the neutral will be recognized.

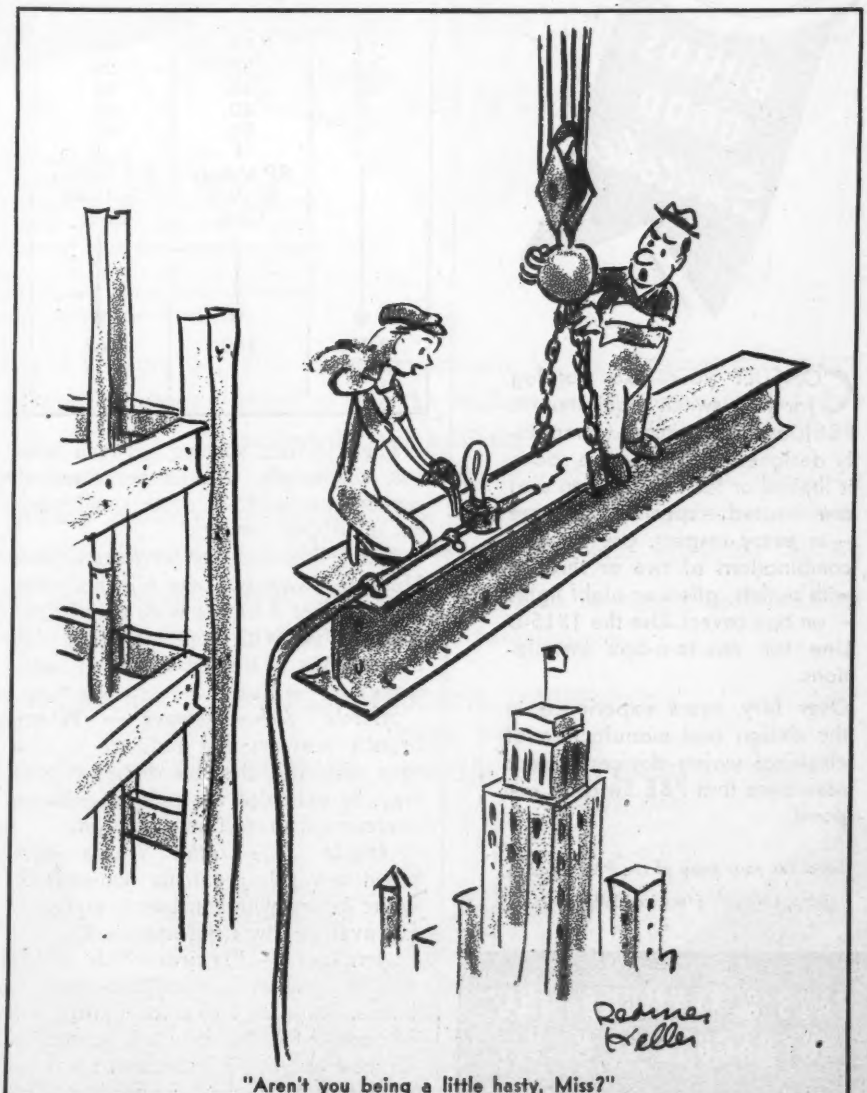
The question of grounding portable equipment was referred back to the article committee and *the Electrical Committee voted to establish a committee to study this subject in detail.*

Article 300—Wiring Methods—Secondary wiring to electric discharge lamps under 1000 volts may occupy same enclosure as the branch circuits.

Conduit expansion and contraction was referred back to article committee. Next code will have note cautioning that consideration be given this in conduit installations.

Proposed new section 3023 on ground return rejected—covered by Art. 200. Proposal to recognize bare neutral for feeders in rewiring was not approved.

Article 310—Conductors—There will be two types of insulation in new code: Type R (with aging characteristics of Type RP in present code); and Type RH. Conductor sizes 8 and 10 will be



"Aren't you being a little hasty, Miss?"



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Over fifty years experience in the design and manufacture of electrical wiring devices is your assurance that *P&S Switches are good.*

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retained; substitution of sizes 7 and 9 was rejected.

Type T and TW conductors recognized for open wiring up to and including 2,000,000 cm.; for general use (including armored cable and non-metallic sheathed cable)—up to and including 4/0. These insulations can be used in presence of oil or gasoline only if approved by Underwriters for such applications.

Conduit fill for new work with Type T insulated conductors—same as Table 4 in present code, thus permitting some spare capacity. For rewiring in old buildings, fill will be according to last line of Table 11 in present code, with a 50 percent fill for more than four wires.

Current carrying capacities in new code will be in accordance with the following table:

CURRENT CARRYING CAPACITY TABLE

In Conduit, Table I			Insulation Thickness R—RH Only	In Air, Table II	
AWG.	R—RW RU 14–8 T TW	RH		R—RU 14–8 T TW	RH
14	15	15	2/64	20	20
12	20	20	2/64	25	25
10	30	30	3/64	35	40
8	40	45	4/64	55	65
6	55	65	4/64	80	90
↓	RP Values In 1940 Code	RH Values In 1940 Code	↓	RP Values In 1940 Code	RH Values In 1940 Code
↓	↓	↓	↓	↓	↓
2,000 MCM	560	665	8/64	1155	1385

The 2½-inch spacing between 400-volt conductors will be permitted if supports are on 15-ft. centers and spacers on 4½-ft. centers.

Article 354—Underfloor Raceways—Metal raceways not over 4-inches wide and not over 2-inches wide may be installed flush with concrete floors (at present this is limited to 2-inch raceways).

Article 364—Busways — Where branch busways are reduced in size they may, if ⅓ the size of larger busway, be extended up to 50 ft. without overcurrent protection at tap-off.

Article 370—Outlet Boxes—Proposed new rule requiring non-metallic outlet boxes where network piping is not available was not approved.

Article 410—Fixtures—This article will be combined with Article 420 on lamps. A cord connected fixture will be accepted if the fixture is suspended directly below the outlet and no stress is placed on the cord connection. Fixtures weighing more than 50 pounds must be supported independently of the outlet.

Equipment having an open circuit voltage of more than 1000 volts shall not be installed in residential occupancies. Equipment over 300 volts open circuit voltage permitted in residential occupancies only if so designed that no live parts are exposed when lamp is changed.

Transformer and ballast secondary voltage is limited to 15,000 volts. The secondary current rating is limited to 240 milliamperes and shall not be in excess of 120 milliamperes when the open circuit voltage exceeds 7500 volts.

The section requiring lamps, lampholders or both to be designed with no exposed parts when lamps are replaced shall be in force one year after the effective date of the next code. In the interim, section 6013 of the 1940 code will apply.

Article 422—Appliances—will include rules on infra-red drying equipment.

Article 430—Motors—the intent of the IAEI proposals were adopted.

Article 500—Hazardous Locations—was adopted as it appeared in the IAEI preprint of March, 1945. This article is extensively rewritten. In effect, it places all hazardous locations into two distinct categories for each Classification—Division 1 where hazardous conditions are known to exist; Division 2 where hazardous conditions may develop. Specific rules and regulations for each are included. The electrical inspector—the enforcing authority of the code—still has the responsibility of determining if a hazard is or will be present and under which division such a condition will fall.

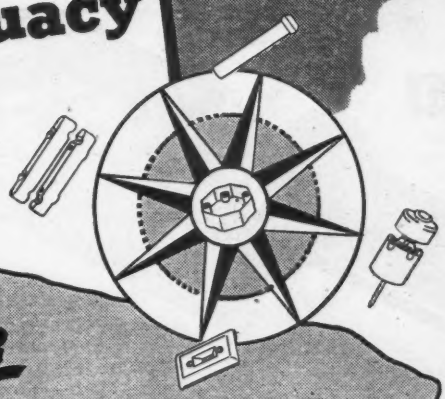
Commenting upon the Electrical

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• Quick installations are accomplished —economical results are realized—complete insulation and protection from the entrance switch to the very last outlet on the system—short-proof and shock-proof qualities of porcelain contribute to dependability—rust and corrosion resistance characteristics make porcelain the ideal material in damp, wet, or dry locations—meets future load increases——allows for easily made alterations and additions.

NEW housing and remodeling of old housing is a top subject now due to the present shortage of residential accommodations.

It's time right now to thoroughly investigate the advantages of Porcelain Protected Wiring Systems both to yourself and your customers. Housing shortages exist not only in one sector but in many. Modern Porcelain Protected Wiring Systems provide every requirement for an adequate wiring program so that the modern results you achieve today extend through a lifetime.

Porcelain manufacturers have studied the needs of the electrical contractor in preparing materials for adequate Modern Porcelain Protected Wiring Systems and are prepared to supply materials for complete Porcelain Installations.

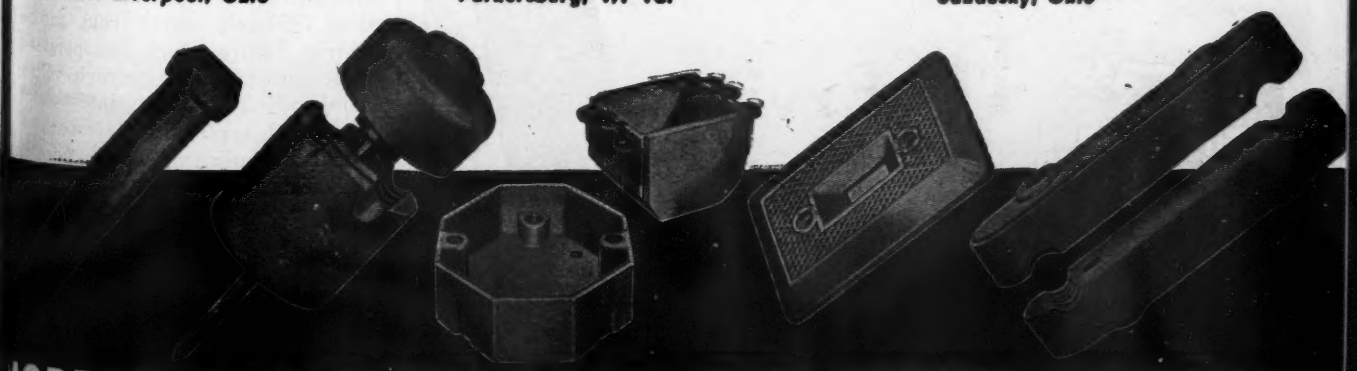
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★ SPECIALTY PORCELAIN WORKS
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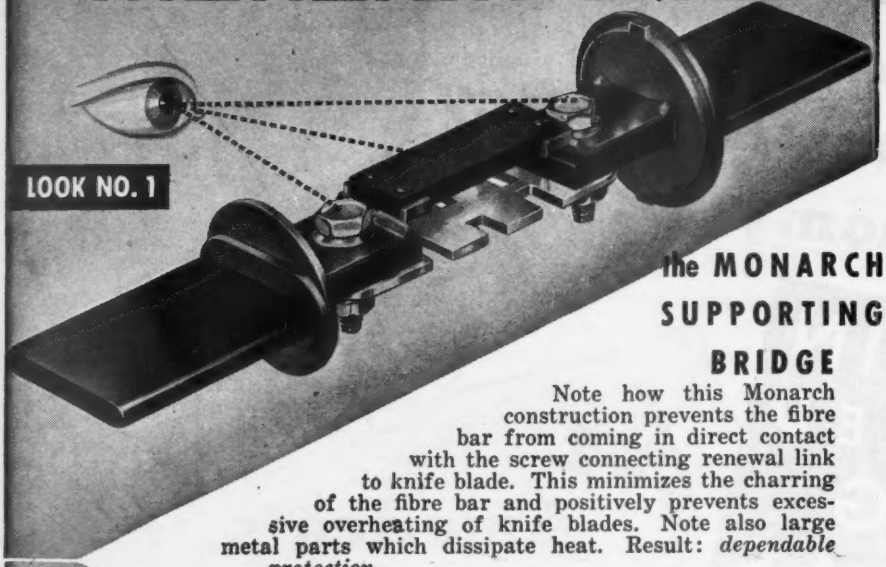
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MODERN PORCELAIN PROTECTED WIRING SYSTEMS

Take a TWO-WAY LOOK AT THE Monarch Fuse

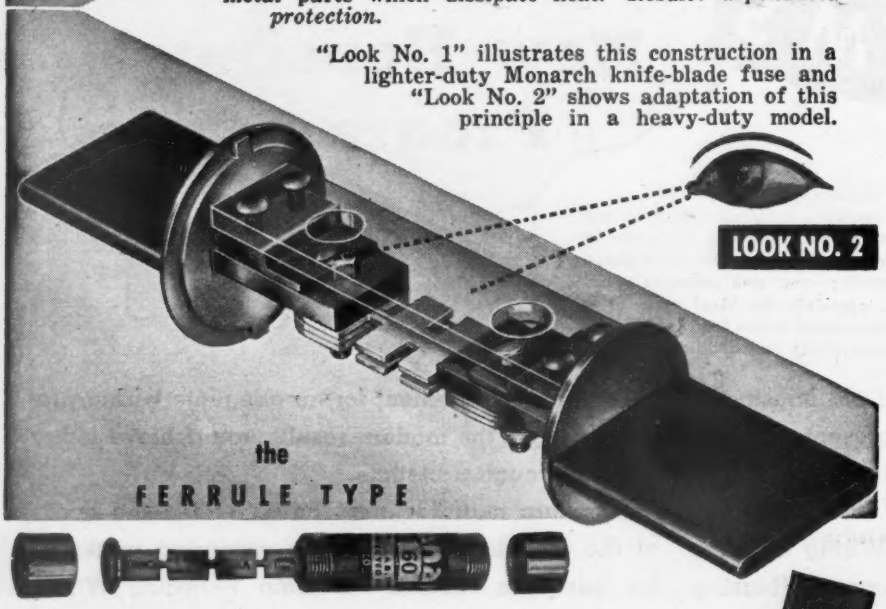


LOOK NO. 1

the MONARCH SUPPORTING BRIDGE

Note how this Monarch construction prevents the fibre bar from coming in direct contact with the screw connecting renewal link to knife blade. This minimizes the charring of the fibre bar and positively prevents excessive overheating of knife blades. Note also large metal parts which dissipate heat. Result: *dependable protection.*

"Look No. 1" illustrates this construction in a lighter-duty Monarch knife-blade fuse and "Look No. 2" shows adaptation of this principle in a heavy-duty model.



LOOK NO. 2

the FERRULE TYPE



Specify Monarch Fuses *for improved* FUSErvice

Monarch RENEWABLE Fuses

MONARCH FUSE CO., LTD.

118 E. FIRST ST., JAMESTOWN, N. Y.

Committee meeting and the proposed new code, Alvah R. Small, Chairman, Electrical Committee, NFPA, revealed that NEMA's proposal for rewriting Article 660 on X-Ray and High Frequency Equipment to cover industrial X-Ray units and installations was referred back to the article committee for study and a report one month hence. At that time it will go out to the Electrical Committee membership for a letter ballot. There is a strong possibility this will appear in the new code. There will be no detailed section on high frequency heating in the 1946 code, he added. Mr. Small lauded the adoption of Article 500, which takes into consideration the degree of hazard, as a more practicable section than that of the present code.

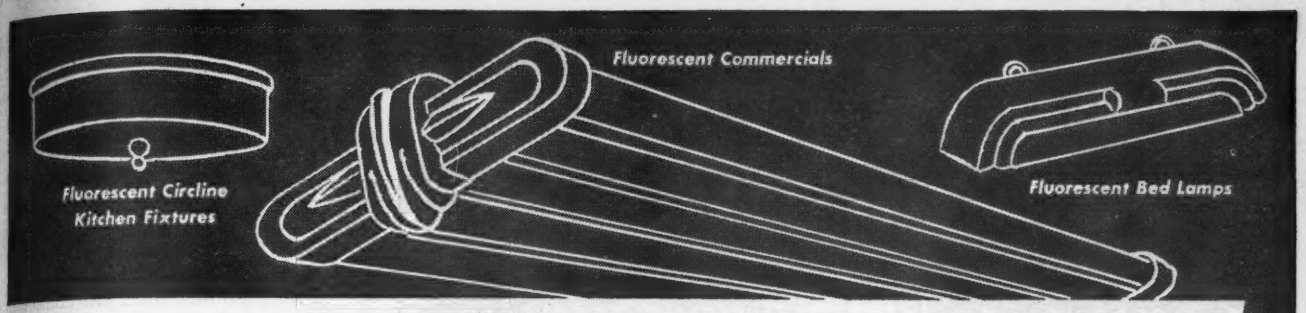
Prolonged discussions of the above report on the new code were held at a code panel session at which time Arthur L. Abbott of New York, author of the National Electrical Code Handbook, and some 15 members and alternates of the Electrical Committee offered interpretations of the new code changes and additions.

The new National Electrical Code will appear in about one year, according to best estimates. The Electrical Committee took action at its recent session to retain the Interim Amendments to the present code in effect until the issuance of the 1946 Code.

Addressing the initial business session of the conference, George W. Reinke, Chicago electrical contractor urged better cooperation between the inspector and electrical contractor. Criticized wiring installations should be reported to the contractor rather than the owner, Mr. Reinke believes, and inspectors suggesting the employment of electrical maintenance men to plant management should recommend legitimate electrical contractors who have the know-how and equipment to efficiently and economically service such concerns.

Conference delegates were treated to lecture-demonstrations of three of the latest developments in the electrical industry. Discussing the development of cold cathode lighting, R. Hultgren, vice-president, General Luminescent Corporation, Chicago, presented the operation, maintenance and safety features of the low-voltage (450-volt operating, 750-volt start) cold cathode lighting fixture which incorporates a safety cutout to kill the high voltage during relamping and maintenance.

Practical applications of industrial electronic equipment was outlined by W. B. Frackleton, industrial electronics specialist, General Electric Co., Chicago. The inspector's concern for safety can be limited to wiring to the unit, he stated, since the devices come



for Fluorescents of the future!

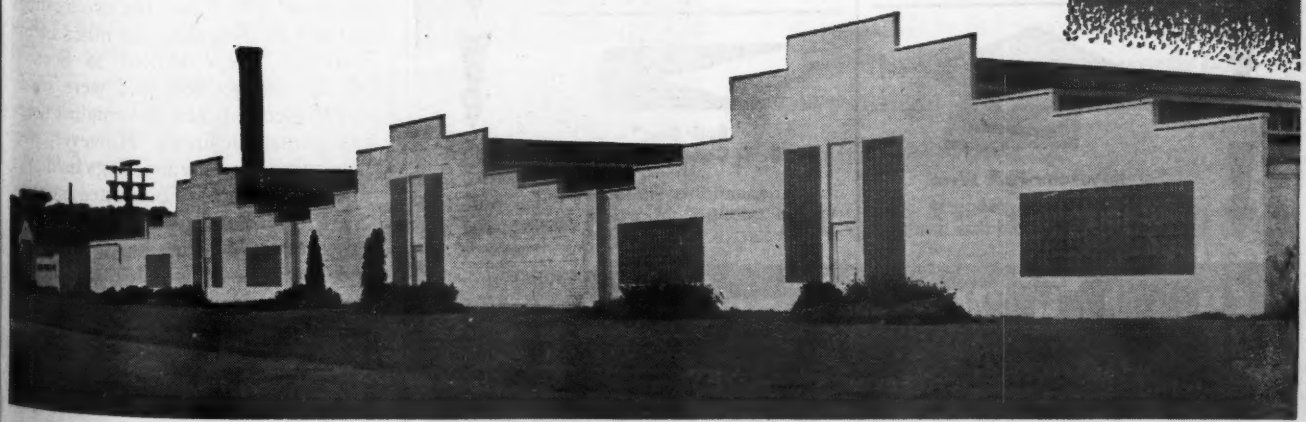
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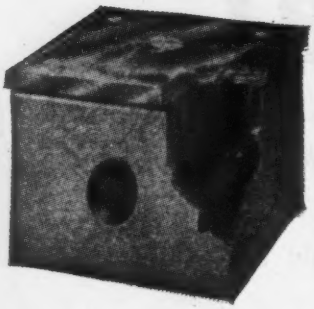
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FLOOR BOXES ★ WIRING SPECIALTIES

FULLMAN MANUFACTURING CO. QUALITY AT LATROBE JOB SUPREMACY LATROBE, PA.

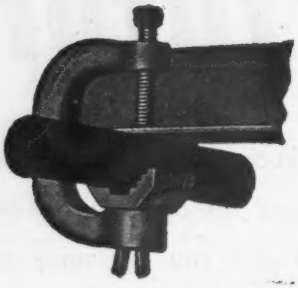
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5" x 5" x 4" Floor Junction Box with Adjustable Cover

Large variety of Junction Floor Boxes with Adjustable covers in stock—Facilities also for special sizes.



No. 470—"Bull Dog" Pipe or Conduit Hanger.

May be used as ground clamp—But is in greatest demand for hanging ½", ¾" and 1" pipe or conduit to steel beams up to ⅜" thick.



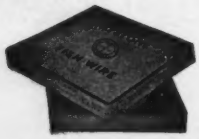
"Bull Dog" Insulator Supports

Malleable iron of high tensile strength—Convenient for fastening porcelain or glass insulators to exposed steel framework. Four sizes to accommodate all standard porcelain or glass insulators.



No. 150 Box
No. 207 Nozzle

Adjustable watertight box for use in concrete or wood finished concrete floors.



Keystone Fish Wire

Flat Steel Wire properly tempered and of dependable quality.



"Bull Dog" B. X. Cable Staples

These dependable staples in any desired quantity. Cartons, kegs or barrels.

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completely wired according to regulations.

The fundamental theory and operation of induction and dielectric high frequency heating was presented by Willard Woll, industrial heating engineer, Commonwealth Edison Company, Chicago. Using models and sketches to illustrate the theory, Mr. Woll was able to bring the discussion down off the highly technical level and completed his talk with a comprehensive list of industrial applications to speed production.

At the final business session, the following officers were unanimously elected: President—George C. Munroe, Springfield, Mo.; first vice-president—A. H. Welklin, Ft. Wayne, Ind.; second vice-president, R. C. Loughead, Detroit, Mich.; secretary-treasurer—F. H. Moore, Indianapolis, Indiana. Otto E. Radtke, Cleveland, Ohio was elected a new member of the executive committee with W. C. Cale, Toronto, Canada and R. C. Loughead, Detroit, Mich., reelected for a 3-year term. Re-elected as cooperative and associate members of the executive committee were E. P. Hodges, Denver, Colo. and C. F. Lyons, Dayton, Ohio. Roy Burgess, Chicago, is a new member of the executive council with K. W. Adkins, St. Louis, Mo., and R. D. MacDaniel, Indianapolis, Ind., reelected for a 3-year term.

PACIFIC COAST INSPECTORS MEET

War played hob with the inspectors in more ways than one. It shot their Code full of substitutes and interims. It even threw their annual meetings out of phase, after the war had ended, too. The Southwestern Section by fast footwork saved its meeting by running it in two sections. The Northwestern Section had to resign itself to holding its by proxy with the executive committee doing all the work.

Change in date for the Electrical Committee meeting caused quick changes in the Southwestern Section plans. Originally scheduled for the first week in October, the two meetings, one in Los Angeles, the other in San Francisco, were shifted to Sept. 19 and 21, respectively and were chiefly held to elect officers and conduct necessary annual business. However, since these were the only meetings held prior to the Electrical Committee meeting, IAEI Secretary, Victor H. Tousley presented to each group a number of Code changes on which there was difference of opinion in order to get the feeling of the California inspectors on them.

Synthetic wire insulation was severely criticized at the Los Angeles

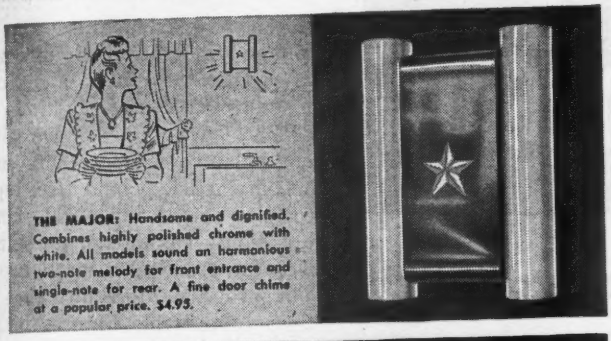
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Ask today to see the outstanding new models . . . all exclusive with Edwards . . . by Lurelle Guild, noted designer.

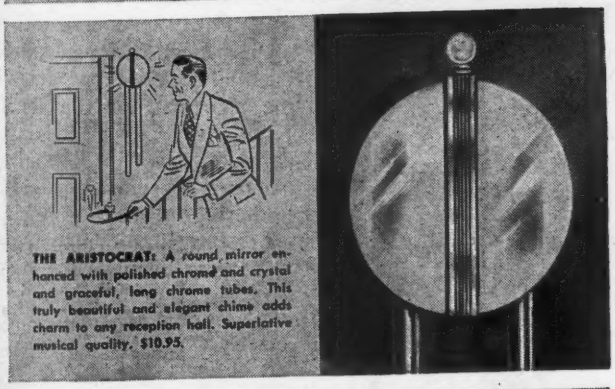
Edwards and Company, Norwalk, Conn.
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THE MAJOR: Handsome and dignified. Combines highly polished chrome with white. All models sound an harmonious two-note melody for front entrance and single-note for rear. A fine door chime at a popular price. $4.95.



THE EMPRESS EUGENIE: An antique-white bracket shelf in lovely classic design encloses superlative chimes. This is one of a unique Edwards group, in which the chime enclosure serves a decorative purpose. Suitable for every home. $7.95.



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And now we are well under way in putting over a full promotional program to support wholesalers, contractors and dealers . . . a program that promises to dwarf all previous efforts.

We're missing NO *bets!* You already know what a whale of an advertising campaign Edwards is putting on to reach American home-owners. To that, we're adding mats for local advertising . . . catalogs and literature for mailing . . . *and these are only the* BEGINNING*!*

Here's the way *we* look at it . . . and here's the way *you* should look at it: The Edwards line is a popular money-maker for both of us . . . and it's worth *both* of us putting it over WITH A BANG!

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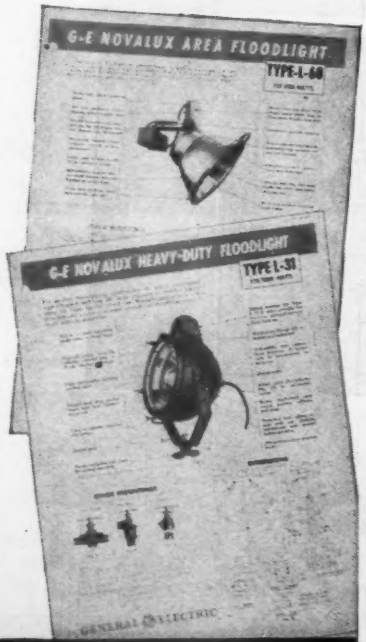
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200 or 250 watts, Type L-29	GEA-4303
300 or 500 watts, Type L-30	GEA-4304
750 or 1000 watts, Type L-31	GEA-4305
Heavy-duty, cast aluminum	
200 or 250 watts, Type L-38	GEA-4325
General purpose, sheet aluminum	
300 or 500 watts, Type L-49	GEA-4311
750 or 1000 watts, Type L-43	GEA-4310
Sports and area, sheet aluminum	
750 to 1500 watts, Type L-68	GEA-4333
Area, open porcelain enamel	
300 to 1500 watts (Type L-45)	GEA-4433
(Type L-46)	GEA-4432
Handy, sheet aluminum	
200 watts, Type L-66	GEA-4346
Underwater	
100/250/400 watts (Type L-33)	GEA-4438
500/1000/1500 watts (Type L-41)	GEA-4439

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GENERAL ELECTRIC

meeting, although not at the San Francisco meeting. Gripes against it were that it was too stiff, seemed to be hard drawn instead of soft drawn copper, that the insulation was often off center, that it ran or softened in warm locations, that it split near the terminals if bent sharply into a box or outlet, that it was difficult to pull in or out of conduit, particularly in the larger sizes.

Simultaneous opening of all conductors in motor controllers as suggested for changes in Article 380 was considered impractical and particularly in view of electronic control devices. Color coding of wires was desired continued, as a practical help to both contractor and inspector in tracing circuits. Common neutral, because almost never installed with the right sizes of neutral, was turned down. Higher voltage in lighting circuits was opposed vigorously as unsafe. Long taps or loops to control lighting circuits (2121-2) was voted down also. The lengthy, involved procedure suggested in the Article Committee report for revision of Article 500—Hazardous Locations, was thought to be too complex for practical inspection purposes. The proposal to require that connections to portable fixtures be soldered rather than permit disconnecting plug and receptacle was argued warmly but turned down.

L. P. Dendel, Lansing, Mich., president of IAEI, and Victor H. Tousley, Chicago, secretary-treasurer, attended both meetings. Dendel addressed the group, stressing the need for educational work by inspectors among the many new electricians who have entered the field through war work.

E. E. Larson, city electrician, Riverside, Calif., president of the Southwestern Section, presided at both meetings, although they were opened by the chairman of the local chapters. Jesse Ross, City electrician, San Bernardino, chairman Southern California Chapter, was host to the Los Angeles gathering; Harry Romick, inspector, San Francisco, chairman Northern California Section, the San Francisco session.

At the election of officers M. C. Sandles, supervising inspector, Oakland, was named president; H. G. Ufer, western superintendent, Underwriters' Laboratories Inc., first vice-president; H. C. Moore, Modesto city inspector, second vice-president; and H. L. Gerber, chief inspector San Francisco, reelected secretary-treasurer. On the executive committee in addition to the officers were named E. E. Larson, Nick Siggins, O. D. Butterfield, and J. A. Hill. B. C. Hill, Oakland superintendent of the electrical department, now first vice-president IAEI, was named for the IAEI Executive Council; R. H.

AUSTIN *"Patented"* FLANGED TYPE WEATHER-PROOF ENTRANCE CAP

UNITED STATES PATENT NO. 2,234,640



No. 1580-C

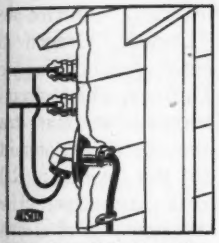
BEHIND THIS FLANGE LIES ONE OF THE POPULAR "PATENTED" FEATURES OF THE ORIGINAL AUSTIN FLANGED TYPE WEATHER-PROOF ENTRANCE CAP

BEWARE OF IMITATIONS AND INFRINGEMENTS

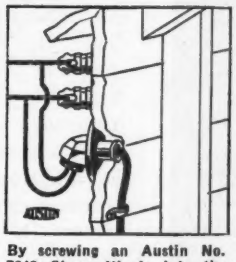
The enthusiastic response that greeted the original Austin "patented" flanged type, weather-proof entrance cap has resulted in many imitations and infringements. Such an ovation establishes beyond doubt that this invention is a great contribution to the electrical industry.

Electrical contractors everywhere have approved it as a great accomplishment and one that had been too long neglected. Today, the original time-tested No. 1580-C Austin weather-proof flanged type entrance cap remains the best and most economical to install. It is fully protected by the United States patent No. 2, 234,640, issued March 11, 1941, and license has been granted to a few manufacturers. All others are infringements.

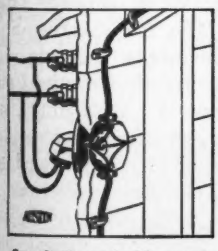
To be sure—to be safe that you are getting the original—the best, look for the U. S. Patent No. 2,234,640 stamped on the fitting.



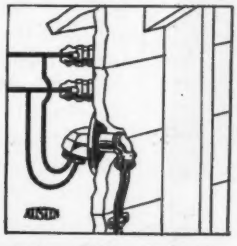
Austin No. 2004 Connector screwed into hub rigidly and permanently holds non-metallic sheathed cable in the fitting.



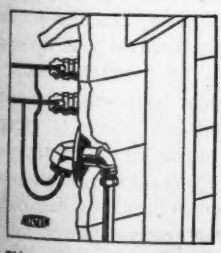
By screwing an Austin No. 7842 Chase Nipple into the hub non-metallic sheathed cable may run directly into the fitting.



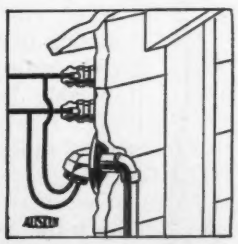
Can also be used with an outlet box by using Austin No. 7842 Chase Nipple which goes through bottom knockout and screws into hub.



Austin 9063-V Angle Box Connector screwed into the hub for armored cable or non-metallic sheathed cable.



Thin wall conduit is easily connected to the hub by using No. 7671 EMT Angle Connector.



For ½" Heavy Wall Rigid Conduit use Austin No. 450 ½" Short Elbow.

INSIST ON THIS "PATENTED" WEATHER-PROOF FEATURE

One of the important "patented" features of the Austin flanged type weather-proof entrance cap is the annular recess in the back of the flange or plate.

When the flange is secured in position, this recess, filled with weather-proof compound, makes a perfect moisture and air tight seal. The recess squeezes the compound around the hub and into the hole and protects the sealing material so that it cannot be tampered with or receive knocks which might injure the weather-proof joint.

The cap is made of aluminum and cannot rust or deteriorate, eliminating unsightly rust streaks on the exterior of the building.

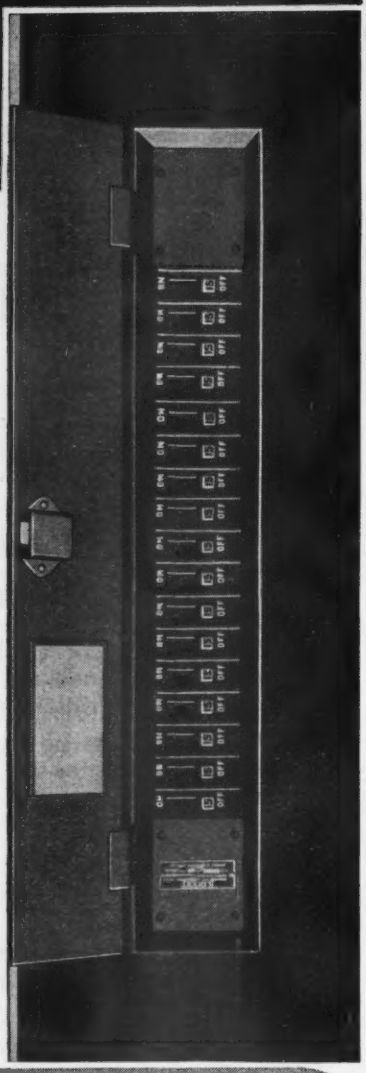
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Your reconversion problems are simplified with Kinney "Quicklag" Column-Type Circuit Breaker Panelboards. They mount in standard H-beam columns, saving space and improving accessibility.

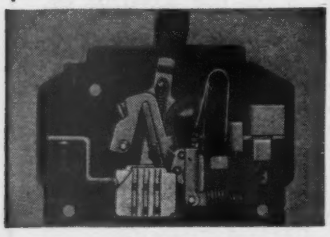
They increase operating efficiency, too. Production delays and work stoppages due to current interruptions are reduced, giving better, more positive to vital small tool and lighting circuits.

"Quicklag" circuit breakers resist tripping in harmless momentary overloads, yet trip with amazing speed on short circuits and prolonged overloads. This unique action of "Quicklag" thermal-magnetic circuit breakers provides new freedom from work stoppages—giving you at the same time surer protection against serious circuit damage — a double saving in time and money.

Priced lower than other panelboards with fewer features, Kinney "Quicklag" Panelboards are available in standard and column types, 4 to 40 circuits, with 15 to 50 ampere breakers. The Kinney line also includes "Nofuze" Circuit Breaker panels for lighting and power distribution, "Switch-and-Fuse" panels, and Switchboards engineered to specific control problems.

THESE KINNEY "QUICKLAG" FEATURES MEAN GREATER CIRCUIT PROTECTION

- Full time delay on overload
- Quick opening on short circuits
- Deionizing principle arc quench
- Individual Bakelite cases
- Single or double-pole breakers supplied
- Listed by Underwriters' Laboratories



Interior view shows "Quicklag" breaker's sturdy construction and unique Thermal-magnetic principle.

* Listed by Underwriters' Laboratories

PANELBOARDS **KINNEY** SWITCHBOARDS

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Manahan, member of the Electrical Committee and B. C. Hill alternate.

Northwestern Meeting

Originally planned for a two day session at Longview, Wash., the Northwestern Section, due to local difficulties at Longview had its meeting there cancelled Aug. 30, and had to content itself with an executive committee meeting Sept. 24, at Seattle to conduct the necessary business of the year, elect officers and make its plans for the future. Harry Hilpert, Washington State electrical inspector, Seattle, president of the Northwestern Section presided. Dendel and Tousley attended the meeting. Other prominent inspectors were there.

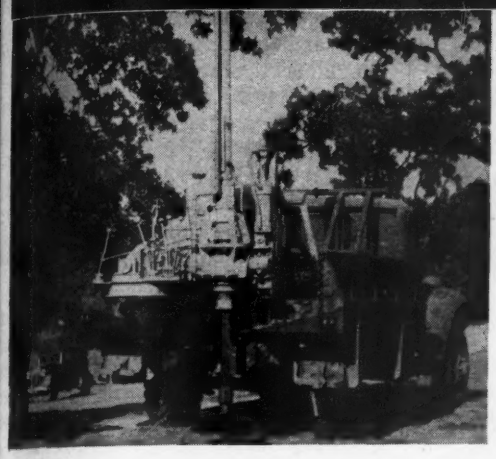
The nominating committee report, which will be submitted to the membership for letter ballot, was approved. It recommended the following as officers for the new year: C. S. Alger, supervising meter and service inspector, Puget Sound Power & Light Co., president; R. J. Larrabee, Underwriters Laboratories Inc., first vice-president; L. W. Carlisle, Oregon state electrical inspector, second vice-president; W. L. Gaffney, chief electrical inspector, Tacoma, secretary-treasurer; and on the executive committee, in addition to the officers: Ralph Grant, electrical inspector, Havre Mont.; D. J. Wolters, chief electrical inspector, Salt Lake City; R. E. McDonough, Montana Power Co., Butte; R. A. Church, Puget Sound Power & Light, Seattle; W. I. Downie, Trumbull Electric Mfg. Co., Seattle; S. B. Clark, Northwestern Electric Co., Portland. Member of Executive Council elected was W. L. Gaffney, and L. W. Going, chief inspector, Portland, was named Electrical Committee member, with Gaffney as alternate.

In time remaining some of the code changes previously mentioned were brought up for discussion. The IBEW proposal in regard to "correct principle" grounding came up first and received considerable discussion. Prohibiting of bare neutral was favorable to the majority particularly because of probable damage to insulated conductors. However, objections to grounding of range frames to the neutral were given no support because of extensive experience in so grounding ranges by many northwestern power companies without ill effects.

SAN DIEGO CONTRACTORS MEET

The Electrical Contractors Division of the San Diego County Bureau of Radio and Electrical Appliances held its initial meeting on September 21, 1945, in the San Diego Gas & Electric

JAQUES EARTH BORING MACHINES



WHAT USERS SAY

"We cannot praise the Jaques Earth Boring Machine too much. We have used three different makes of machines on this job, and in my estimation, it is a whole lot more suitable than a $16,000 machine which was mounted on a caterpillar tractor. We have not found any soil we could not dig except rock. We have even blasted out the rock and finished digging a six-foot hole which we have seen other machines on this project refuse to do."

"We wish to advise you that we are using our Jaques Earth Boring Machine at present and have found it efficient and durable. From all indications, it is as good or better than any other Earth Boring Machine."

"We have had our machine in operation for four months and have found it entirely satisfactory. This has been used mostly in the construction of rural lines. Our actual hole digging time has averaged 2.5 minutes per hole. We like this machine so much that we have ordered another one."



WITH HYDRAULIC CONTROLS

Do the Job

QUICKER • BETTER

Hydraulically controlled to insure ease of operation and provide automatic regulation of cutting speed to suit the texture of the soil, this new, improved JAQUES EARTH BORING MACHINE does the job quicker, better—at a saving both in manpower and cost.

If you have an earth boring job to do, here's the machine to use. Note some of its principal features:

1. EASE OF OPERATION—All hydraulic controls readily accessible to operator. No manual labor required.
2. HYDRAULIC PLUMBING—Controlled by hydraulic power.
3. SPEED—The hydraulic feed automatically regulates the speed of cutting to suit the texture of the soil. Holes are dug faster.
4. SELF-CONTAINED UNIT—When not in use, this machine can easily be removed from truck and stored.
5. POWER—Auxiliary motor of ample capacity—truck motor not used in boring.
6. ANCHOR HOLES—Anchor holes as well as vertical holes may easily be bored.
7. SIZE AND DEPTH OF HOLE—Any size up to twenty-four inch diameter bit may be used and hole may be bored to a depth of eight or nine feet.
8. WEIGHT—3,400 lbs. complete.



If you have a tough earth boring job to do, entrust the job to JAQUES. Wire or write for full information and prices today.

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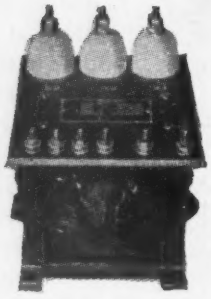


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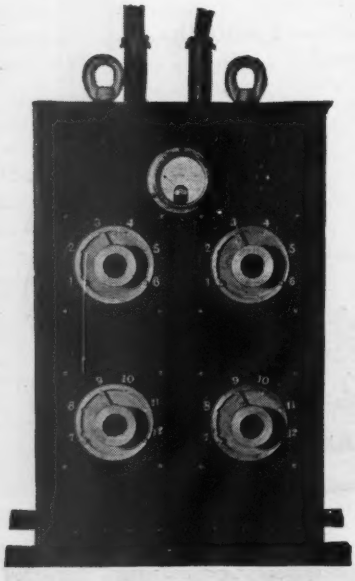


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All voltages
Single phase
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Standard 75 KVA. 1-phase
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Co. auditorium. Attended by 86 electrical contractors and jobbers, the meeting was opened with a greeting by the Bureau's past president, William Powell. Mr. Powell pointed to the need for a higher standard of wiring and electrical installations in the new postwar homes, and declared that there should be a mutual understanding of this need on the part of the contractors.

Outlining the services rendered customers by the San Diego Gas & Electric Co.'s lighting department, C. M. Thompson, lighting consultant for the utility, explained that his department was aiding commercial establishments in their lighting problems by providing engineering service with advice, suggestions, and recommendations given to both domestic and commercial lighting customers. Thompson went on to state that the contractors can expect a good amount of business as a result of the lighting department's plans to put men in the field to promote better lighting. Pointing out the obstacle of financing in making lighting improvements, he urged the contractors to work out systems which will make it easy for customers to purchase and pay for good lighting equipment.

P. P. Pine, power sales engineer of the San Diego utility, pointed to San Diego County's huge agricultural power potential and its industrial power growth. He urged the contractors to cooperate with the local Chamber of Commerce in endeavoring to bring new businesses to San Diego, stating that they would find new business among new industries. Also, industries should be sold on the advantages of the new industrial appliances; it is up to the contractors to work toward this end. Mr. Pine stated that San Diego County now ranks 23rd in the nation in the



Lobby session on water heater services with John E. Wise (left), electrical engineer, Wisconsin Industrial Commission, helping solve the problems of electrical inspectors E. C. Roth, Sheboygan; and Warren Lalande, Rhinelander, Wis.

value of farm crop produce, that it is anticipated that 97 percent of California farms will have connections to high-lines within five years. These, coupled with the fact that more liberal extension policies are being planned by utilities, will result in a rich rural market for the electrical contracting business. Mr. Pine urged contractors to cooperate with farm groups and associations as much as possible, and recommended the establishing of rural specialists in the field.

E. W. Meise, superintendent of domestic electric sales for the San Diego Gas & Electric Co., told the group of great sales opportunities ahead and urged contractors to meet together frequently to unify policies. Mr. Meise stated that in a recent domestic survey made in San Diego it was found that 95 percent of San Diego homes had only two circuits. Insufficient for prewar appliances, these will be far from sufficient for our postwar appliances. It was estimated by Mr. Meise that 20,000 new homes will be built in San Diego during the next 5-yr. period; that 8,000 homes will be constructed under Title 6 of the FHA, and that 50,000 old homes will be completely rewired. He stated that financial institutions stand ready to aid in financing rewiring of old homes and good wiring in new ones.

A talk on Better Wiring for Better Living by Elbert W. Kramer of Westinghouse Electric Corp. and chairman of the Better Wiring Committee for the Pacific Coast Electrical Association concluded the meeting. Elected to be chairman of the Electrical Contractors Division was Jess Zweiner of the Zweiner Electric Co. He will represent the contractors on the Bureau of Radio and Electrical Appliance Board of Directors.

WISCONSIN INSPECTORS REVIEW NEW STATE CODE

The recently published Fifth Edition, Volume 2 (wiring) of the Wisconsin State Electrical Code was the major topic of discussion at the 19th Annual Meeting of the Wisconsin Chapter, IAEI held at the Hotel Raulf, Oshkosh, Wisconsin, on Sept. 13-14. Some 45 electrical inspectors from all parts of the state registered at the two-day session to present their views and obtain a universal interpretation on many of the new features of the code. Tied in with this were lively discussion periods where numerous inspector field problems were solved.

One of the new features of the code is the added degree of electrical and mechanical safety assured by rules

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which prohibit the installation of fluorescent fixtures designed to be mounted and plugged into conventional incandescent lampholders originally designed to hold only the weight of enclosing glass gloves and not considered substantial enough to support the weight of fluorescent units. Plug caps and receptacles on all fixtures are not approved; all fixtures must be installed in a permanent manner, supported from at least one existing or new outlet with fixture stud; and fixture connections to circuit conductors must be made with solderless connectors or soldered joints. Wiring methods and materials rules of the new code were explained by George H. Andrae of Milwaukee, a member of the Code Committee representing the Wisconsin Electrical Association.

There is a possibility that technical sub-committees will be appointed at the October meeting of the Electrical Committee, NFPA, to study electronics and high frequency heating, revealed V. H. Tousley, national secretary-treasurer, IAEI, during his discussion of the proposed new National Electrical Code. His opinion is that all wire in the new NEC should be termed Type R with the elimination of the RH designation on the larger sizes. Possible changes in the new NEC as Mr. Tousley sees them: An entirely new article on conductors; a rewritten article on transformers considering non-flammable transformer oils; article on Hazardous Locations entirely rewritten with some changes in principles; new articles on Welding, Machine Tools, and Control Circuits; inclusion of cold cathode lighting by altering present rule limiting installations to 600 volts *open circuit* to read 600 volts "operating"; section on Motors revised to a large extent with many new rules based on IAEI suggestions. Mr. Tousley also visualizes the use of gas-tube indirect lighting in residential living rooms, thus eliminating to a large degree table and floor lamps—the cords of which always were a considerable hazard.

Reviewing electrical contractor problems on a national basis, E. H. Herzberg, executive manager, Milwaukee Chapter, NECA, emphasized the increase in electrical work during the war, jumping from the normal 1½ to 2 percent of the building dollar to about 15 percent and as much as 48 percent in remodeling of old plants—a development which irked the general contractors. He explained the necessity of moving the NECA national headquarters to Washington to watch the general picture and protect the interests of the electrical contractor. Through the exceptional employee-employer relations, cooperation and assistance in the electrical industry, NECA was able to retain the electrical work for the electrical contractors, he added. Comment-

ing on the high average age of electrical workers (Detroit—56 yrs., Milwaukee—50 yrs.) he outlined the increased activity of apprenticeship training, committees for this having jumped from 47 to over 200 throughout the country. Mr. Herzberg recommended the reorganization of the defunct Code Interpretation Committee of the Electrical Industry in Wisconsin so that a statewide universal interpretation of the new code could be obtained (a motion to that effect was later approved by the conference with the inspector members of the committee to be appointed by the Chapter Executive Committee). All meetings of the Wisconsin Chapter, NECA, for the balance of the year—with prospects of some next year—are to be Code Meetings with inspectors invited as guests of the contractors, according to Mr. Herzberg.

At the final session of the conference the following officers were elected: Chairman—A. B. Middlemas, Milwaukee; vice-chairman—A. W. Krumm, Manitowoc; secretary-treasurer—J. E. Wise, Madison. Members of the Executive Committee are: W. W. Wilke, Milwaukee; George Rothe, Fond du Lac; P. E. Widstein, Menasha; and Alfred Addler, West Allis.

VICTORY LIGHTING JUBILEE IN NEW YORK NOVEMBER 26-30

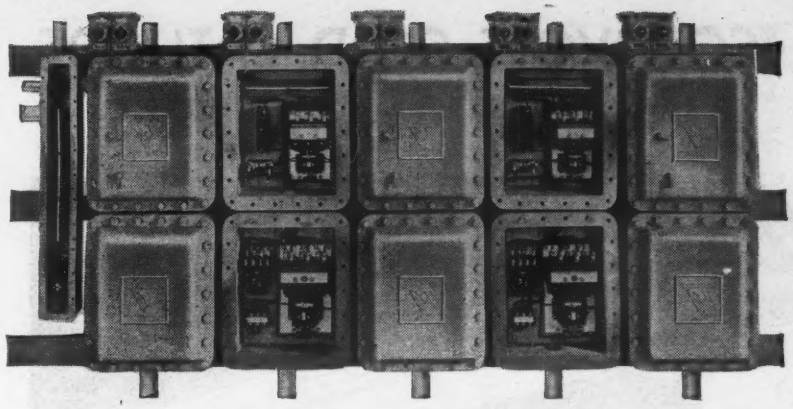
What promises to be the largest and most comprehensive lighting exposition in the history of the industry will be held in New York City at the 17th Regiment Armory, November 26 through the 30th. It is sponsored by General Electric's Lamp Department and called the "Victory Lighting Jubilee."

The 5-day exposition will, for the first time, have brought together under one roof a representative cross-section of the combined talents of the lighting fixture and portable lamp industries. Virtually every manner of fixture designed to help "bring the sun indoors" for commercial, industrial and residential needs will be featured in the forthcoming postwar victory lighting exposition.

The outstanding event was conceived by E. D. Stryker, sales manager of lighting equipment promotion for G.E. Lamp Dept., Nela Park, Cleveland. He will serve as director of the lighting jubilee exposition, assisted by Arthur F. Loewe of lamp department's advertising division.

In announcing the event, Mr. Stryker said in part:

"This Victory Lighting Jubilee has for its principal objective the collective presentation of all the postwar thinking

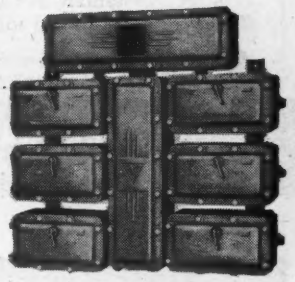


EXPLOSION PROOF CONTROL PANEL FOR FIVE GROUPS OF ELECTRICAL STRIP HEATERS INSTALLED ON ETHYLENE GAS PIPE LINES & DRUMS. THE PANEL MADE UP OF FIVE SECTIONS & EACH SECTION CONTROLS SEPARATELY ONE GROUP OF HEATERS. A MOTOR OPERATED SEQUENCE SWITCH & TEMPERATURE INSTRUMENTS (NOT SHOWN) OPERATES THE VARIOUS CONTACTORS & RELAYS SO THAT THE HEATERS ARE CONNECTED IN PARALLEL OR IN SERIES DEPENDING ON THE TEMPERATURE REQUIREMENTS.

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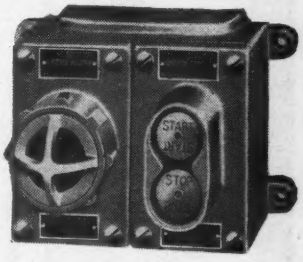
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Over the years R&S has pioneered in the development and standardization of precision-built control equipment in keeping with industries' expanding requirements of new processes and codes.



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A large variety of standardized explosion-proof enclosures is available for grouping and assembly of control and power units in panel form, at minimum cost and without the usual delay of special designs.



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R&S Standard Enclosures have wall sections permitting a great variety of conduit arrangements and sizes to suit job requirements. This simplifies material lists and reduces inventories caused by field changes.

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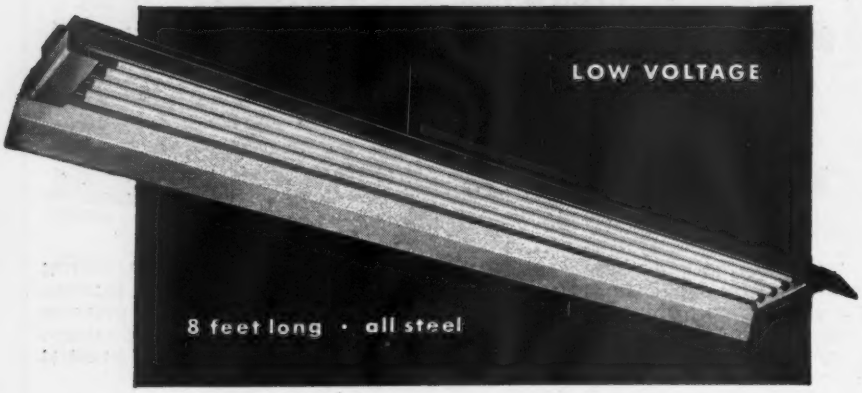
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RUSSELL & STOLL COMPANY

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Here is the new Colovolt industrial fixture, one of a complete line of industrial and commercial "packaged" units. Equipped with the standard 93" Colovolt 10,000 hour lamp, Colovolt fixtures may be used singly or in continuous line lighting in multiples of 8 feet. Instantaneous starting, no flickering, guaranteed for 1 year except for failure due to breakage are extra advantages of the Colovolt Cold Cathode low voltage fluorescent lamp. The long life expectancy of Colovolt lamps may be realized even when constantly turned on and off, and *pre-scheduled re-lamping, with no loss of production or time, is now possible with Colovolt installations.*

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and designing of the fixture and lamp industries for mass acceptance of buyers and users throughout the nation. G.E. and its allied equipment manufacturers believe the exposition will well serve the public interest. It should stimulate immediate production of peacetime goods to satisfy the pent up demands created during the past five years."

Invitations to exhibit at the exposition have been sent to several hundred interior lighting fixture manufacturers and makers of portables in all parts of the country.

In scores of booths to be erected at the armory exposition building, fixture makers will be afforded an opportunity to display recent and up-to-the-minute lighting fixtures, portable lamps, germicidal and infra-red units for use in a host of fields.

While the exposition will not be open to the general public, it is expected that the jubilee will attract an untold number of representatives from the electric utility, wholesaler, contractor, chain store, furniture store, building, and architectural fields.

CHICAGO HOLDS ADVANCED LIGHTING SCHOOL

The fall lighting classes jointly sponsored by the Chicago Lighting Institute and the Illinois Institute of Technology in cooperation with the Chicago Section, IES (the 13th evening lighting course of this group since January 1943) are under way with a full enroll-



Veteran's training in the electrical field is explained by V. E. Anderson (center), Plymouth, Wis., electrical instructor of the Wisconsin State Board of Vocational and Adult Education. Electrical inspector A. W. Krumm (left), of Manitowoc and electrical engineer H. G. Plank, Manitowoc Public Utilities are attentive listeners.

ment of 25 students. The course of twelve lectures and six laboratory sessions, running from October 1 through December 17, is open to architects, contractors, designers, engineers and lighting salesmen who have completed the previous Institute courses in "Fundamentals of Illumination" or who have had the equivalent in experience.

Unlike many of the previous courses which were a wartime educational venture underwritten by the U. S. Office of Education, this year's school involves a tuition fee of $15 per student—a condition that apparently did not preclude an over-subscription to the course.

"Design Problems for Tomorrow's Lighting" is the central theme of the course and the curriculum is so arranged that actual field inspection trips can be made to study luminaires; office, store and window, and industrial lighting. Data secured on such trips are carefully studied and analyzed at succeeding classroom sessions held at the Chicago Lighting Institute.

The series of two-hour lectures—one per week—will cover the following subject matter: Review of illumination terms and fundamentals; practical methods for solving lighting problems; evaluating lighting installations in the field; luminaires; office, store and window, and industrial lighting; floodlighting, street and sports lighting; ultra-violet and infra-red applications.

The three-hour laboratory sessions at the Illinois Institute of Technology will permit the enrollees to study the construction, calibration, and application of footcandle, brightness and visibility meters. They will also learn how to determine, by test, the candle power distribution of a fluorescent fixture; study energy concentration, temperature and time characteristics of infra-red lamps; also the operating characteristics of ultra-violet black light, sun and bactericidal lamps.

Students satisfactorily completing the entire course will receive certificates, but the course is not acceptable for college credit.

Instructors are: Lecture—John Harrington, Commonwealth Edison Company; Laboratory—Ralph Lusk, Commonwealth Edison Company; and Arthur Sandberg, Chicago Surface Lines.

MINN. ELECTRICAL ASSOCIATION APPOINTS FIELD REPRESENTATIVE

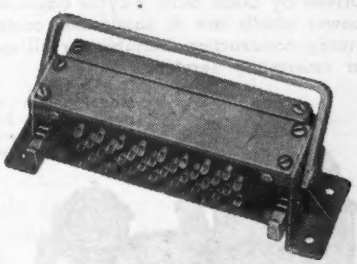
A. Earl Anderson, St. Paul, Minn., was recently appointed field representative of the Minnesota Electrical Association in Minneapolis. A graduate

SPECIALTY



WITH HUNDREDS OF VARIATIONS

The "DP Line" of Cannon Plugs—rack and panel type connectors—was developed for use where space is limited. But so popular are its many features—rectangular shape, easy panel mounting, compactness with capacity, to mention a few—that the line has been expanded to include hundreds of styles and sizes. Pictured above is DPR 62-33 and 34 assembly with its geared bail disconnect mechanism. Although it carries 62 contacts, it is as easy to use as an ordinary household plug. Other standard DP plugs include models with as many as 135 contacts.



CANNON ELECTRIC

If you are interested in the various applications of this type of Cannon Connector—for radio, instrument assemblies, aircraft, and communication applications—write for the Cannon DP Bulletin. Address Department A-231, Cannon Electric Development Co., 3209 Humboldt Street, Los Angeles 31, Calif.

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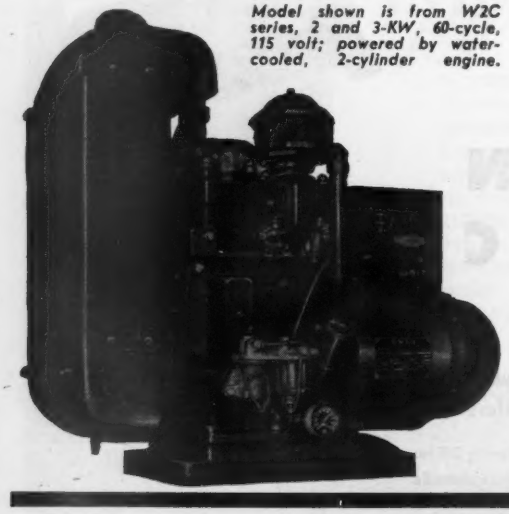
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in vocational education of the Stout Institute, Menominee, Wis., Mr. Anderson's career embodied such positions as: Director of vocational education in a high school, journeyman electrician, financial organization work, automotive sales, and inspector of naval ordnance—a position he held until V-J Day. He attained the rank of Captain in the Field Artillery Corps during his service in World War I.

The officers of the Minnesota Electrical Association, in making the appointment, felt that Mr. Anderson's interest in the electrical field plus his general knowledge and experience will serve the members to excellent advantage in dealing with present and postwar problems.

G. W. WESTON NAMED MANAGING DIRECTOR OF SOUTHERN CALIFORNIA ASSOCIATION

Gerald W. (Jerry) Weston has been appointed managing director of the Southern California Radio and Electric Appliance Association with headquarters in Los Angeles.

For the past two years Mr. Weston was with the War Production Board in Washington, D. C. in charge of the section handling the electrical appliance, radio, and mechanical repair shops of the country. Prior to this he spent a year with the National Electrical Contractors Association in Washington as assistant to the general manager; and 19 years as manager of the Electric Association of Kansas City, Mo. He is a past-president of the International Association of Electrical Leagues, and a graduate of Purdue University.

MAILLARD PILOTS INDIANAPOLIS LEAGUE

The appointment of Albert L. Maillard as managing director of the Electric League of Indianapolis, Inc., effective September 15, war recently announced by Dan Hess, president of the group. The new appointee fills the vacancy created by the resignation of Walter O. Zervas on June 1.

An electrical engineer with an impressive record as consultant and supervisor of construction in this country and abroad, Mr. Maillard was in charge of electrical facilities at the huge Jayhawk Ordnance Works at Pittsburg, Kansas during the war. Previously, he was consulting electrical engineer for various large electric utilities.

During 13 years association with the Kansas City Power & Light Company, he organized that city's Air Conditioning Council—the first in the country. He is a member of the A.I.E.E., A.S.M.E. and A.S.H. & V.E.

The Board of Directors of the League, in approving Mr. Maillard's appointment, felt that his wide experience and leadership in the electrical industry, his technical knowledge and organizing ability would be of particular value to the members of the group during the postwar era.

N.D. TO TRACK FARM WIRING BOTTLENECK

Unless efforts to recruit or train 150 journeymen electricians and about twice that many helpers succeed, there will be a lot of sorely disappointed farmers in North Dakota within the next two or three years. Their postwar dreams of household electrical convenience and production aid will vanish —for a time at least.

REA cooperatives in the state plan to electrify 30,000 farms in the next three years and it has become obvious that the present group of 250 licensed electricians in North Dakota couldn't begin to meet the demands of this rural program plus the expanding needs of urban areas. According to *Rural Electrification News,* 300 or 400 trained electricians working steadily could handle the farm wiring program.

Typical of the shortage of skilled electricians on REA work is the experience of one cooperative—900 farms signed up for electric service and only



REA inspectors Milton Haugestuen (left), Barron County Electric Cooperative, Barron, Wis.; and Thomas E. Henderson, Cooperatives for Midcentral Wisconsin, New Auburn, Wis. relax during recent Oshkosh meeting of the Wisconsin Chapter, IAEI.



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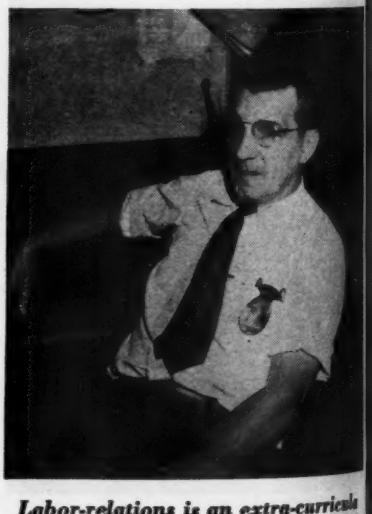
one licensed contractor in the area to do the work.

Sensing the gravity of the situation Governor Aandahl recently called a meeting at Bismark to discuss the problem. In attendance were representatives of the state board of electricity, state agricultural college, state unemployment service and the state extension service; officials of the state electrical contractors association, master electricians association; leaders of state REA Co-ops, farm organizations, AFL and CIO; officials of REA and Veterans Administration.

Suggestions of this group were based on the possibility of a rapidly growing labor pool of returning servicemen and war workers who had been trained to do some type of electrical work, but who are wholly unfamiliar with farmstead wiring requirements and techniques. *Rural Electrification News* states that the consensus of this group was that some type of training course might be set up to equip these men to take the examination of the state licensing board.

The state college representative reported that his institution was ready to offer a course (from Nov. 1 to March 15) covering building wiring plans, electrical code requirements and practical installation techniques. The VA representative indicated that returning servicemen interviews revealed that many were seeking jobs in the wiring field.

The school idea evolved as the best method to train wiremen and guarantee proper safety standards, code enforcement and efficiency. Also it would preclude hazardous substitute makeshift wiring by untrained co-op members.



Labor-relations is an extra-curricula activity of Charles A. LeMire, head of the LeMire Electrical Construction Company, Flint, Michigan. He is a member of the Labor-Relations Committee of the new Michigan Chapter, NECA and his firm is now busily engaged in electrical reconversion work in the Flint area.

Governor Aandahl concurred adding "We want good contractors, good electricians, approved wiring and no compromise with safety rules on our farms." He immediately started the wheels turning by appointing an action committee of conference members to survey the electrical manpower needs of the state—the number of wiremen now available and the number needed in each county. A second committee will recruit all semi-trained men desiring to do electric wiring. The unemployment office will make a statewide survey to seek out trained men who want to get into wiring and the Veterans Administration will turn up veterans who desire additional training.

With this four-pronged search underway, North Dakota hopes to secure enough men to take the proposed course and be ready as apprentice wiremen by spring when the rural wiring program will start rolling.

NEW CONSTRUCTION OUTLOOK

The lifting of wartime restrictions has put the home construction and allied industries in a position to begin the vast task not only of catching up with the backlog of demand for new homes but also of putting long neglected houses in a proper state of repair and modernization, according to FHA Commissioner Raymond M. Foley.

Two highly significant events have occurred recently:

First, removal of WPB War Conservation Order L-41. This makes it possible, so far as Government is concerned, for home construction to proceed on a peacetime basis.

Second, relaxation of the Federal Reserve Board's Regulation W. This will enable home owners to repair and modernize their properties on the financial terms available to them before the war.

"For a while material and skilled manpower shortages may prevent the construction and repair program from getting into full swing," said Commissioner Foley. "But a much more dangerous retarding influence confronts us—the inflationary trend in the real estate market. Sky rocketing prices on old and new houses as well as on modernization and repair work can easily wreck the bright prospect before us.

"The Government expects home construction to be primarily the job of private enterprise. Management is entitled to its fair share of profit and labor to a fair wage, but neither one nor the other should seek or expect advantages to the detriment of the consuming public of which they themselves are in fact



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You tell us where, and we will tell you how Electric Feedrail can serve your cranes, hoists, movable tools, lights or test lines.

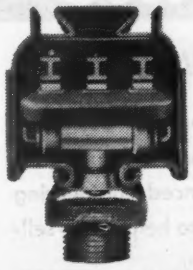
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When you plan production layouts, you can get more production from fewer portable tools such as drills, reamers and polishers by using Electric Feedrail. Fixed outlets and long cords are eliminated. You just slide the electrical equipment along overhead and bring it down to the work.

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Workers are protected from dangerous contact with exposed live parts.

Why not ask us to send an engineer to look over your plant layout?



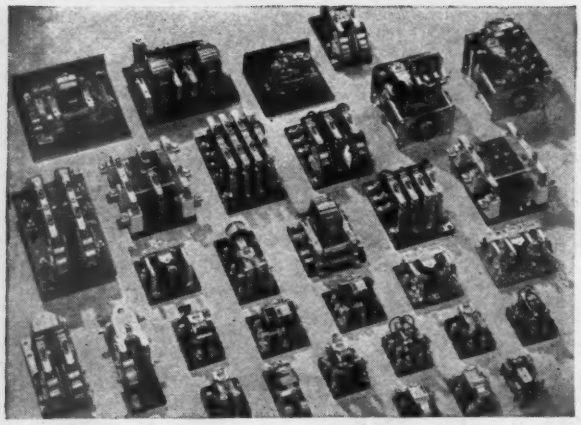
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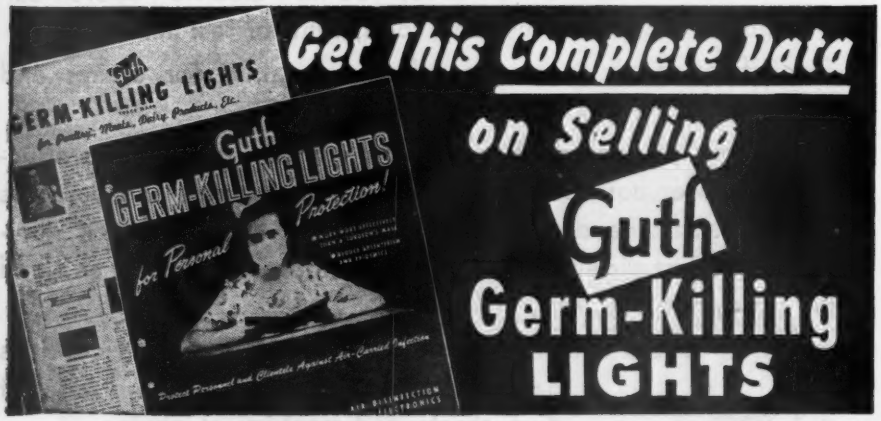
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a part. In its own long range interests, private business should avoid adopting any short-sighted policy of excess profits to be gained from the temporarily unbalanced supply and demand condition of the market.

"If industry, labor, finance, and Government cooperate wisely in meeting the inflation menace, the President's goal of a million or more new homes a year should be attainable. The situation has in it the alternatives of sound, long-continued prosperity in the building industry or a very serious set-back at an early date."

FLORIDA NECA CHAPTER SELECTS NEW OFFICERS

Officers of the North Florida Chapter of the National Electrical Contractors Association were named at an incorporation meeting in the headquarters at 120 East Forsyth Street, Jacksonville, Fla. They are T. E. Satchwell Jr., president; O'Neal Mattox, vice president, H. A. Sonnenberg, treasurer and Jack Schaeffer, secretary and business manager. The directors are H. L. Hall, H. G. Miller, U. S. Pattillo and George N. Delk.

The chapter, according to Mr. Schaeffer, will operate throughout North Florida and in Georgia as far north as Savannah.

SALT LAKE CITY ELECTRICAL ASSOCIATION

Reemployment of Elias J. Strong as fulltime manager of the Intermountain



New chairman of the Wisconsin Chapter IAEI, A. B. Middlemas (right) of Milwaukee discusses circuit protection with C. W. Gallup, Bussman Mfg. Company's Milwaukee representative.

Electrical Association, Salt Lake City, and beginning of expanded operations of the association has been announced by Ora H. Barlow, president.

Reconversion of electrical factories to civilian production, lifting of home-building restrictions and the tremendous amount of pent-up demand for all types of electrical products necessitated the expansion, Mr. Barlow said.

For the past three years, Mr. Strong has been secretary to Gov. Herbert B. Maw of Utah. Prior to that he was manager of the Electrical League of Utah, predecessor to the Intermountain Electrical Association.

CONTINUES TO GAIN CONSTRUCTION VOLUME

Construction volume in the 37 states east of the Rocky Mountains continued to gain moderately in August, it was reported recently by F. W. Dodge Corporation.

Contracts awarded last month totaled $263,608,000, a gain of two percent over July, and 55 percent over August 1944.

The volume of construction of buildings to be used for manufacturing purposes expanded substantially, the August total of $75,456,000 being a gain of 46 percent over July and 88 percent over August of last year.

Although residential building in August declined eight percent from July's total, it was 83 percent higher than in August, 1944. The total amount involved in last month's residential contracts was $42,711,000.

Privately owned construction continued to dominate last month's activity, representing 74 per cent of the total. It accounted for 90 per cent of non-residential building, 93 per cent of residential building and 35 per cent of public works and utilities.

NEMA'S EDUCATIONAL PROGRAM ON ARMORED CABLE

The Armored Conductor and Flexible Metallic Conduit Section of the National Electrical Manufacturers Association is sponsoring an educational and technical program on armored cable.

It is intended to demonstrate to the various industry groups the important part which this wiring material will assume in meeting the tremendous post-war demands for an adequate, flexible, safe and economical wiring system.

The Section's Technical Committee and electrical engineer are carrying on studies and field investigations concerned with technical aspects of the construction and use of armored cable and its accessory items. The studies

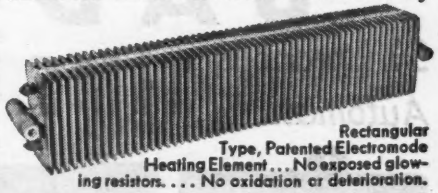
PREPARE FOR COLD WEATHER NOW with *Electric Unit Heaters*



Electromode illustrated above, in models 10 to 60 KW sizes, is for ceiling or wall suspension only. Smaller models, 1.5 to 7.5 KW sizes, may be suspended or used as portable Unit Heaters.

Now is the time to figure your cold weather heating requirements in order to be prepared when the need arises. Be ready to have heat-in-a-minute, anywhere, conveniently supplied by Electromode Electric Unit Heaters. Factory rooms, exposed areas, isolated buildings, watchman houses, hard-to-heat areas or departments—are but a few places where you can safely and easily install Electromodes.

Users have found that installation is as simple as hanging an electrical fixture, with no maintenance of piping and fittings. Electromodes furnish heat quickly, efficiently and economically, at any location where wires can be run, with no transmission heat losses en route to heater—no consumption whatever when not "ON". Electrical energy is converted 100 per cent into heat, and the warmed air is fan-circulated and distributed downward by adjustable deflectors.



Rectangular Type, Patented Electromode Heating Element... No exposed glowing resistors.... No oxidation or deterioration.

Electromodes owe their great efficiency, long life, and freedom from fire or explosion hazard to the patented heating element. This is a one-piece, finned, aluminum encased heating element. Since the fins are an integral part of the casting, there are no dead air spaces to hinder efficient radiation. Because of this exclusive design and large convection surface, Electromodes have great B.T.U. output (from 5122 to 204,900) at a safe, low operating temperature. Electromode Unit Heaters are made in a wide range of standard capacities and all can be automatically controlled by thermostat if desired.

HOW TO ESTIMATE FOR PROPER SIZE ELECTROMODE

The "Watts Per Cu. Ft." method for roughly estimating the heat loss for rooms of average construction and from 0° F to 70° F.

DESCRIPTION	WATTS
1. Interior room, little or no outside exposure	1.25
2. Average rooms, moderate windows and doors	1.50 to 1.75
3. Rooms with severe exposure, great window, door space	2 to 4
4. Isolated rooms, cabins, watch houses, similar buildings	3 to 6

EXAMPLE FOR ROOM OF *AVERAGE* EXPOSURE (Use factor 1.75)
12 x 13 x 10 = 1560 cu. ft.
1560 x 1.75 = 2730 watts (2.73 KW)
Use 3 KW Heater (Electromode AN-30)

EXAMPLE FOR ROOM WITH *SEVERE* EXPOSURE (Use factor 4)
10 x 13 x 9 = 1170 cu. ft.
1170 x 4 = 4680 watts (4.68 KW)
Use 5 KW Heater (Electromode BN-50)

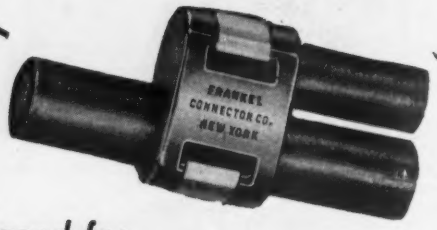
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Type	Poles	Switch Capacity	Case
MI (Synchronous)	1	50 A. at 125 V	16 Ga. Steel
M 2 "	2	50 A. at 125/250 V.	16 Ga. Steel
RM "	1	50 A. at 125 V	Cast Iron
RM5 "	2	50 A. at 125/250 V.	Cast Iron

RELIANCE AUTOMATIC LIGHTING CO. RACINE WISCONSIN



HENRY M. DREHER

are being made to explore improvements and possible new developments, and results will be embodied in the educational program as soon as justified.

An important phase of the program is an educational motion picture entitled "The Armored Cable System of Wiring." This film shows in a popular way the complete manufacturing processes and testing of armored cable and its component parts.

The presentation of the films, and technical talks and discussions relative to the Section's products, will be carried on by Henry M. Dreher, the Section's electrical engineer. In his nationwide travels, Mr. Dreher will meet with various industry groups such as electrical contractors, wholesalers, engineers, inspection authorities and electrical leagues.

Company members of the Armored Conductor and Flexible Metallic Conduit Section of NEMA are: American Flexible Conduit Co., American Metal Moulding Co., Circle Wire & Cable Corp., Clifton Conduit Co., Inc., Columbia Cable & Electric Co., Crescent Insulated Wire & Cable Co., Inc., Eastern Tube & Tool Co., Inc., General Electric Co., Northern Electric Company, Ltd., Okonite Company, Paranite Wire & Cable Corp. Div. of Essex Wire Corp. and Triangle Conduit & Cable Co., Inc.

KRUG REPORT PREDICTS HIGH CONSTRUCTION LEVELS

In a report to WPB, J. A. Krug, Chairman, has outlined prospects for the years ahead. Present estimates, admittedly tentative, project a construction activity of $4.5 billion in 1945, rising to $6.5 billion in 1946. Publicly financed activity dropped 13 percent in August as stop orders were sent out to a large number of active

military and industrial jobs upon the cessation of hostilities. Total war facility construction cutbacks are expected to hold the third quarter volume down to $1,272,000,000, since not all of the slack can be taken up by the rising volume of private work. An overall volume of $1,167,000,000 is expected for the four quarter, of which $785,000,000 is expected to be for private account. New privately financed factory building will represent the greatest volume and is expected to reach $206,000,000 put in place. This will be almost three times the volume of the fourth quarter of 1944 and well above the $169,000,000 quarterly rate of 1941.

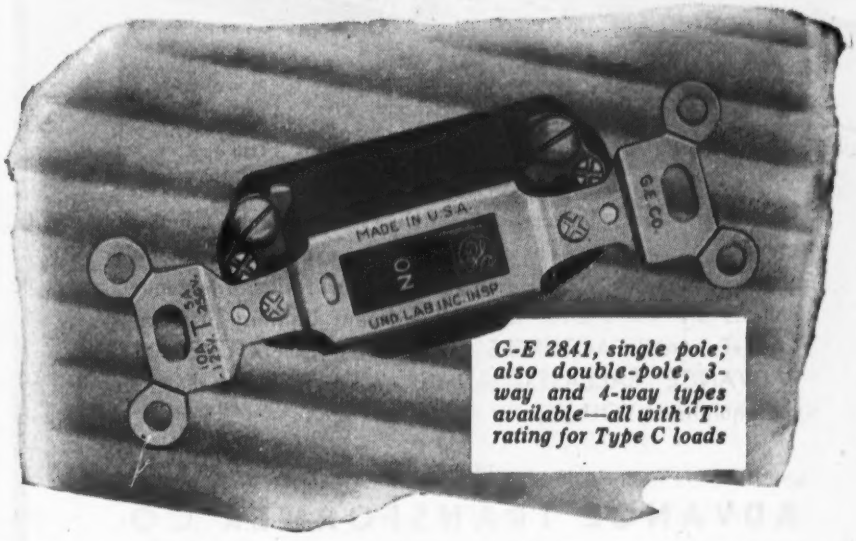
Of the 6.5 billion dollar rate estimated for 1946, about 4.4 billions is expected to be for private account. Factory building and major alterations to existing plants are estimated at 950 million dollars, plus about 75 millions of publicly-financed industrial facilities.

Unlike industrial building, privately financed residential construction will only begin to approach the top postwar level in 1946, even though the estimated $1,525,000,000 in this category is almost 2½ times the expected volume of 1945. This segment of the construction industry is notoriously sluggish in its response to new construction demands. Even if production of critical materials is greatly increased, many months will pass before material and component inventories are built up at the local supply house level (the source of supply for many hundreds of small contractors) and building organizations dormant during the war are reconstituted. Government-financed residential work is expected to increase in 1946 by 75% over 1945. Non-residential building in 1946 is expected to double 1945, but at this level it would be well below the rate of the good prewar years. It would also fall considerably short of the level necessary to make an effective reduction in the accumulated deficiencies of building in this category. Public highways and new farm construction and utilities will show substantial gains in 1946 but will only begin to bite into the accumulated backlog. It is hoped that 1946 will see the employment of over 1,000,000 workers in new construction work.

Since the conversion of peacetime industry was entirely inadequate to supply the voracious demands of global war, it was necessary at first to divert scarce materials, machinery, and manpower to building and expanding war plants and related facilities (even at the expense of current production) to permit the raising of the production level to the point required by the military services.

From an annual rate in 1940 of

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1. *The box* is made of Textolite. Strong without bulk. It is narrow and shallow to allow a maximum amount of wire room. Resists oil and moisture.

2. *Blades* are securely anchored in Textolite blade carriers giving permanent alignment. Construction is simplified. There are no washers to absorb moisture.

3. *Contacts* are correctly positioned by the box. Dust cover fastened to stay in place.

4. *Large binding screws* for top wiring accommodate No. 12 wire.

5. *Cross bar* is securely fastened to box and has wide mounting ears. Provides correct alignment. Ears are washer type and can be broken off to bush up switch when necessary.

These high quality switches are neat in appearance, light in weight and highly resistant to breakage. They are available with brown or ivory-colored handles.

For further information see the nearest G-E Merchandise Distributor or write to Section D1151-8, Appliance and Merchandise Department, General Electric Company, Bridgeport, Connecticut.

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about 2 billion dollars, facilities expansions more than doubled in 1941. In 1942, of course, the pressures reached their peak, and the total reached an all time high at almost 8.5 billions.

After the third quarter of 1942, the trend was downward almost without interruption. But despite the general downtrend, the rate of construction and equipment deliveries on the more urgent programs—synthetic rubber, aviation gasoline, aluminum, iron and steel, ammunition, aircraft—increased as the war effort went into 1943 and showed no very substantial drop until 1944, when most of the objectives had been attained.

As the volume in the more urgent categories declined, expansions in those groups which had been sidetracked began to rise, but the overall trend continued downward. By the first half of 1945, the rate was only 2.7 billion dollars annually—less than a third the average for 1942.

The proportion of government-financed construction was naturally heaviest in those categories where there was the least assurance of postwar absorption of the facilities by the industrial economy. This means that a good deal of the federally-financed plant is in a marginal position. Of the $3,840,000,000 invested in the aircraft industry during the war (89% federal funds), a large part was in plants which are likely to be unusuable in the postwar period. There will also be a considerable proportion of the $2,527,000,000 spent for shipbuilding and repair facilities and of the large amounts invested in explosives and shell loading plants which must be written off.

The problem of disposal of Government-owned steel plants is already a thorny one. While $1,278,000,000 of public moneys went to building new steel making capacity, the industry itself expended $896,000,000. The government plants have geographic location in their favor, but the industry would appear to be over-expanded from the intermediate range viewpoint. In the non-ferrous metals group, also preponderantly financed by government money, aluminum and magnesium bulk large, and their future is surrounded by question marks.

Private financing was heaviest proportionately in aviation gasoline, chemicals, coal petroleum products, food processings, machinery and electrical equipment and miscellaneous manufactures with peacetime outlets. With none of these does reconversion loom as a serious technological problem. The only problem lies in the extent to which expanded capacities can be utilized in the future.

CONSTRUCTION STABILIZATION ACT OF 1945

On October 2, 1945, Senator James E. Murray (D., Montana) introduced in the Senate a bill, S. 1449, called the "Construction Stabilization Act of 1945". In presenting this bill Senator Murray said:

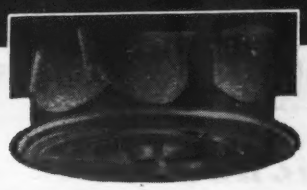
"I have sent to the desk a bill which provides for using public works as a stabilizer in construction. It is proposed to aid in the stabilization of construction by the advance planning of public works and by timing of public construction so as to minimize the seasonal and long-term fluctuations in the total volume of new construction, maintenance and repair work in the United States.

The bill will be effective in securing a steady expansion of construction activity and in maintaining a high level of employment in our most important nonagricultural industry. This industry can contribute a major share of employment in line with the recent action of this Body. However, the goals sought after by this legislation are vital to the economy by and of themselves.

The bill does not contemplate the use of construction to stabilize the total economy nor even to stabilize construction as a whole. Stability does not mean fixing a level of activity and holding to it. It is expected that if this bill becomes law the violent fluctuations in the volume of construction can be reduced. It is expected also that the danger of overbuilding at the top of a boom will be greatly lessened by disseminating information on trends in the volume of construction and on the factors which govern the capacity of the market to absorb new construction. This will help provide local governments and private enterprise with the basis, now lacking, for sound judgment and intelligent planning.

It is difficult to over-emphasize the importance of the role which construction plays in the national economy, and of this legislation and its objectives. Over the twenty-year period, from 1920 to 1939, construction accounted for 11% of the national income. During the same period new construction and maintenance and repair furnished on-the-site employment amounting to 5% of total national employment, and directly or indirectly, approximately 12% of the total national employment. The great automobile industry with its maximum of less than a million employees is dwarfed by the construction industry which, with maintenance and repair, gave a top employment in 1942 of close to 3,500,000 employees on the site, and to another 5,000,000 working in

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the mines, forests, mills and factories producing the things with which buildings are constructed. Indeed, construction is an essential and indispensable ingredient of national prosperity. Inactivity in construction is synonymous with depression.

The bill creates a top policy board composed of the Secretary of Commerce as Chairman, the Secretary of Labor and the Secretary of Agriculture. The Construction Policy Board is a policy-forming agency which makes recommendations to the President and to Congress. In formulating policy, it is aided by two committees: First, a Public Works Stabilization Committee which is composed of the Federal Works Administrator as Chairman, the Chief of Engineers of the United States Army, the Reclamation Commissioner, the Director of the Bureau of the Budget, two members representing states, two members representing municipalities, and two members representing other political sub-divisions.

The bill also establishes a Construction Industry Advisory Committee which performs a liaison function between the Construction Policy Board, the Public Works Stabilization Committee and private enterprise. This advisory committee represents a complete cross-section of the construction industry and includes representatives of labor, builders and contractors, architects and engineers, manufacturers and distributors of material, and other small business and of the public interest.

The Chairmen of these two committees sit with the Construction Policy Board giving the Board the benefit of information acquired by close contact with the field of public works and with the field of private enterprise.

I wish to emphasize the fact that the Construction Policy Board is not an administrative agency. It will make no decisions affecting any particular project. It will not collect source information or conduct research or indulge in publicity. The Board will use the facilities of appropriate, established agencies. When information on construction is required, that information will be secured from such agencies as the Department of Commerce, the Federal Works Agency and the Bureau of Labor Statistics. The Board's findings and recommendations will be announced through the Executive Office of the President.

The Board's primary responsibility is to advise the President and the Congress when it will be desirable to increase or decrease the volume of construction activity. The accomplishment of this will involve increasing or decreasing the rate at which contracts for public works are awarded. It does

not mean that work already under contract will be interrupted, slowed down or speeded up.

The bill also provides for advance planning of Federal and local public works. The advance planning of local public works is to be encouraged so that there will be, at all times, a shelf-program of useful non-federal public works amounting to not less than five billion dollars. To insure advance planning of this shelf-program of non-federal public works, the bill provides for a 150 million dollar revolving fund which may be used to make non-interest bearing loans or advances to State and local governments to defray the cost, or part of the cost, of advance planning.

The bill gives the President authority to direct Federal construction agencies to accelerate the prosecution of Federal public works already authorized or to defer starting authorized but postponable public works when such action is required to prevent unemployment or to prevent competition with private enterprise for available labor and materials.

If the Construction Policy Board recommends acceleration of construction, the President must still request the Congress to authorize the projects and to appropriate the funds needed for the work. Any program for acceleration of public works construction recommended by the Public Works Stabilization Committee is subject to modification by the President and by the Congress. None of the powers of Congress are abridged by this act. No work can be undertaken without Congressional authorization and appropriation. Further, no program authorized by Congress can be arbitrarily set aside. The Federal-aid highway program, for example, or the new Federal-aid Airport program, could not be halted or reduced by the President. Only Congress could take such action, and there will be, as I see it, little need for so acting. The job ahead is to increase construction activity, aiming at ever-higher levels

One important feature of this bill must be emphasized. Regimentation is *not* our goal. The Federal government is not given authority to ride herd over State and local governments nor to compel private enterprise to conform to any bureaucratic program. We seek to establish a lasting framework for the voluntary cooperation of industry, labor and government.

This bill, for the first time, provides machinery for fostering close cooperation between the construction industry and government.

I recommend that this bill be referred to the Committee on Labor and Education for consideration as soon as possible."



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For superior mechanical strength, for ease of assembly, for maximum electrical conductivity, specify *O. Z.* Power Connectors with confidence:

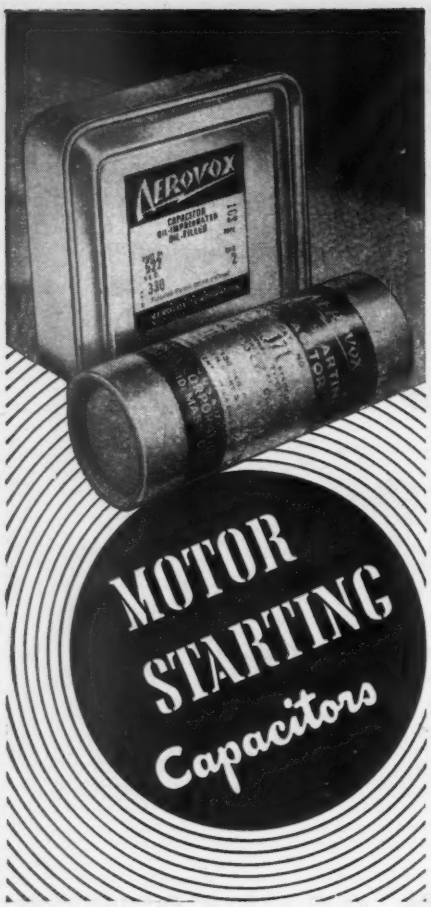
An inter-dependent bolting system makes O. Z. Connectors *stronger.* Their Hex Cup construction speeds assembly — only one wrench is needed for tightening.

And long, dependable service is assured by the corrosive-resistant copper alloy used in their construction.

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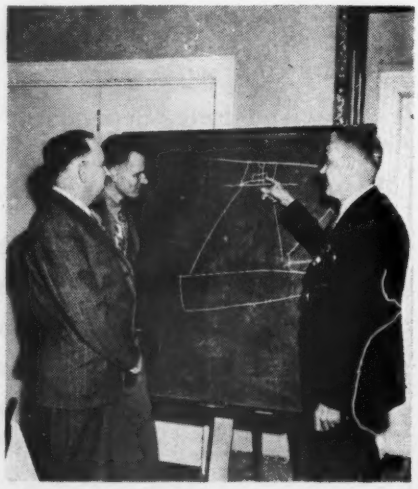
APPRENTICE TRAINING FOR RETURNING SERVICEMEN EXPLAINED IN DETAIL

In reply to the thousands of inquiries from men in service for information on apprenticeship, a comprehensive booklet on the subject has been prepared especially for their guidance by Apprentice-Training Service, U. S. Department of Labor. This booklet, entitled "Apprentice Training for Returning Servicemen," has been written in collaboration with representatives of the educational branches of the War and Navy Departments, and the Veterans Administration.

While the booklet is designed primarily for the men still in the services, it is of equal value to those already released from service, and also to employers and labor organizations, especially in gaining a clear understanding of the veterans legislation as applied to ex-servicemen who are employed as apprentices.

Included in the information contained in this booklet is an explanation of the financial benefits of the veterans legislation which supplement apprentice wages, qualifications required of veterans for these benefits, as well as for apprentice training, procedure to follow, application forms and experience records needed. Among the other data presented is a list of over 100 skilled trades in which workers are trained through apprenticeship and ten major points which identify a bona fide apprenticeship program.

Copies of this booklet may be obtained by writing to Apprentice-Training Service, U. S. Department of Labor, 1778 Pennsylvania Avenue, N. W., Washington 25, D. C.



Blackboard session on fluorescent fixture suspension occupies spare moments of Wisconsin electrical inspectors (L to R) C. N. Sinnott, Kenosha; Joseph H. Dupont, Kimberly; and Otto B. Rode, Racine, at Wisconsin IAEI Chapter meeting.

New! TYMZIT TRADE MARK Triple Feature TOGGLE SWITCH



Tymzit offers amazing new light switch convenience. With the simplicity of a standard toggle-switch, TYMZIT features "delayed-action" and "instant" off. A simple set-screw in the toggle sets TIME-DELAY interval from 5 seconds to 3 minutes. (See illustration). Just flip the Tymzit toggle. The switch says OFF . . . but the light is ON. Then AFTER the selected interval — the light goes out automatically. With slight additional pressure downward, the light is off instantly — Tymzit is revolutionary in principle. There is no clockwork, yet Tymzit is entirely mechanical. The phosphorescent tip makes toggle easy to find in the dark.

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NEBRASKA CONTRACTORS TO SPONSOR APPLIANCE SHOW

At a recent meeting of the Nebraska-Iowa Chapter, NECA, held at the Lincoln Hotel, Lincoln, Nebraska, plans were made for an exhibit of the latest electrical household appliances to be held in the city auditorium, Omaha, Neb., Feb. 26 through March 3, 1946. E. J. Grafentine will supervise the exhibit.

Radar demonstrations will be featured at the show in conjunction with the display of new postwar home appliances. Those attending the show will be eligible to win two major appliance awards daily as well as grand prizes of an all-electric kitchen and a complete laundry according to present plans.

CMP REVOKED

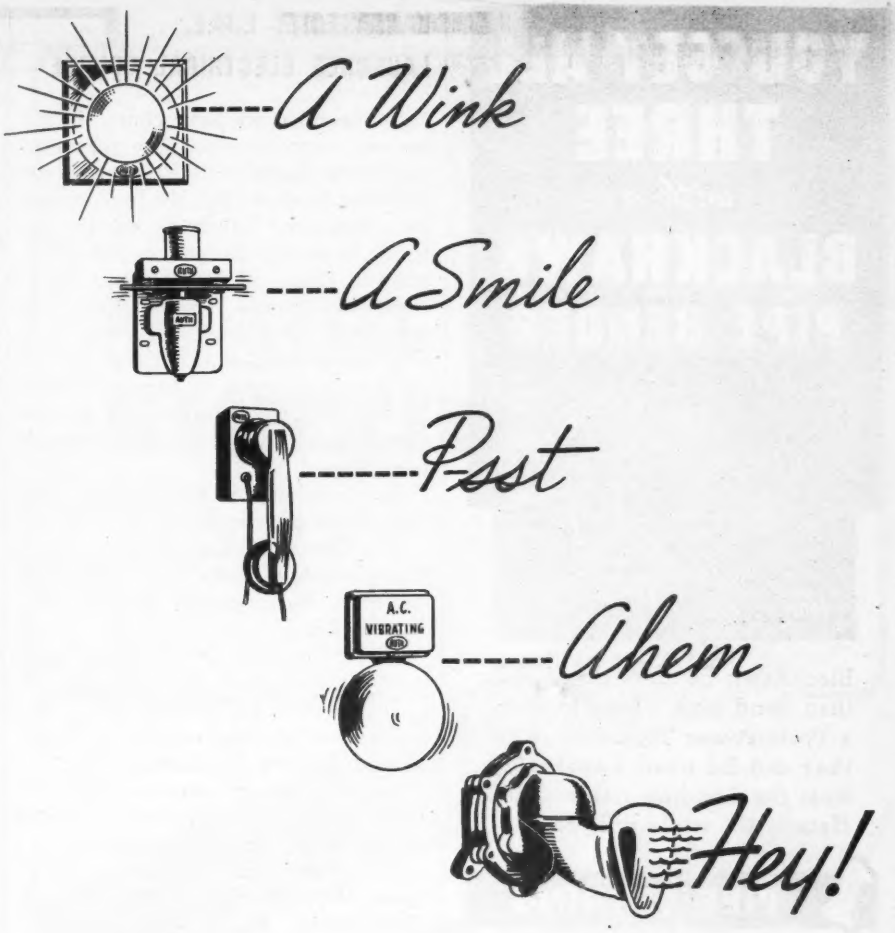
The Controlled Materials Plan for the distribution of steel, copper and aluminum, the most thorough system ever initiated for controlling the flow of critical materials in American war production, expired October 1.

A simplified priorities rating system is being retained by the War Production Board for the relatively few materials and components still in critically short supply. Under this new system a rating may be assigned for certain military purposes and, sparingly, to break production bottlenecks or to meet other unusual circumstances.

Controls on the production and distribution of metals, except tin, lead and antimony, expired with the revocation of CMP and only the emergency AAA rating, MM rating for military needs and the CC rating for emergency civilian requirements remain in force.

In commenting on the passing of CMP, J. A. Krug, Chairman of the War Production Board, said: "Since victory in Europe and over Japan, WPB controls have been amended or revoked as fast as military cutbacks and the materials supply situation permitted. When a manufacturer scans the list of remaining wartime controls, he may feel assured that the small amount of paper work that still may be required in accounting to WPB for his business will not impede his go-ahead plans. Meanwhile he will take with him improved scheduling procedures and procurement methods that were imposed by wartime scarcities of materials and parts, and these will aid in the conduct of the nation's postwar economy."

CMP ended effective last midnight with the revocation of CMP regulations 1 through 9A, and all the directions to them, which were the only CMP regulations remaining on the War Production Board books.



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3 SPECIAL JACK

Compact 10 or 20-ton ram (same as used in pipe bending) works in all directions — and at any angle. Preferred to all other types of jacks.

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KANSAS CITY E.M.E. LAUNCHES ELECTRICAL COURSE

A fifteen-lecture basic course in the use and control of electricity got under way at the Kansas City Power & Light Building, Kansas City, Mo., on October 29. Sponsored jointly by the Kansas City, Missouri, Board of Education and the Electrical Maintenance Engineers of Greater Kansas City, the school will offer weekly two-hour evening sessions on subjects ranging from the theory of electricity to power transmission. Guest lecturers will be nationally known experts in their respective fields.

The following is the planned curriculum for the course:

The Theory of Magnetism and Electricity—Yale E. Witschner, application engineer, Westinghouse Electric Co., Kansas City.

Direct Currents—W. E. Dunn, engineer, Exide Battery Co., Chicago, Ill.

D-C Motors and Generators—J. W. Gustaveson, electrical engineer, Barr-Thorpe Electric Co., Kansas City.

A-C Motor and Generator Theory—Prof. Russell M. Kerchner, Kansas State College, Manhattan, Kansas.

A-C Motors and Generators—C. V. Dunn, electrical engineer, Barr-Thorpe Electric Co., Kansas City.

Transformers — Maloney Electric Co., St. Louis, Mo.

Switches—Richard C. Lipps, electrical engineer, Trumbull Electric Mfg. Co., Plainville, Conn.

Line Starters and Breakers—Frank H. Roby, electrical engineer Square D Company, Milwaukee, Wis.

Meters—J. A. Daly, meter specialist, General Electric Co., Kansas City.

Capacitors—P. C. Cross, application engineer, General Electric Co., Kansas City.

Relays — Sub-station Department, Kansas City Power & Light Company.

Power Transmission—C. C. Cornelius, supt., overhead systems, Kansas City Power & Light Co. C. M. Lytle, supervisor of engineering and estimating, Kansas City Power & Light Co.

Symbols and Schematics—Board of Education, Kansas City, Mo.

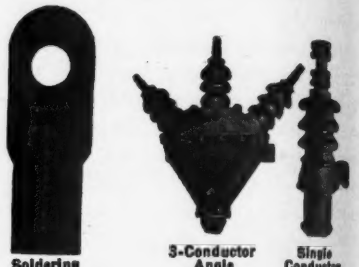
The entire course will be under the personal direction of W. S. Esther, Kansas City Board of Education. He will preside during each lecture and question period as well as supervise the final examinations. All grades will be based on two factors: First—attendance at sessions; second—the marks obtained on final examination.

Cooperating with the Board of Education in arranging and presenting the course is the Electrical Maintenance Engineers Educational Committee composed of chairman John H. Masters, Ray White and Ralph E. Lowell.

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OPA ISSUES MPR 28

Issuance of a new regulation superseding all others governing sales of electrical wire and cable was announced by the Office of Price Administration. It became effective October 29, 1945.

The new regulation, which will be known in the industry as Maximum Price Regulation No. 82—Wire and Cable—, is a revision of Revised Price Schedule 82—Wire, Cable and Cable Accessories—, and will include on its pricing lists every type of wire conducting electricity, including aluminum and nickel-alloy. The old regulation, OPA said, priced only copper, copper-clad and copper alloy wire.

Omitted, however, from the pricing lists of the new regulation are cable accessories (cable connections) and portable "trouble lamps," formerly under Revised Price Schedule 82, which have been transferred to Revised Maximum Price Regulation No. 136—Machines, Parts and Industrial Equipment.

Purpose of the new regulation, OPA said, is to simplify pricing methods and make it possible for manufacturers entering this field to price their products in line with prices already established by other manufacturers.

Pricing methods under the new regulation will be based, OPA said, on the prices of various types of electrical wire in effect on the base dates. These dates are October 15, 1941, for copper wire and March 31, 1942, for electrical conductor wires of other metals which do not contain copper. An exception, however, will be used for wire, both bare and insulated, but even in this case the pricing procedure will be relatively the same as that heretofore employed.

(Maximum Price Regulation No. 82—Wire and Cable—effective October 29, 1945.)

PR 13 STILL IN EFFECT

With civilian buying now generally unrated, the War Production Board announced recently that with a few exceptions preference ratings no longer will apply to special sales under Priorities Regulation 13.

This move was made to facilitate the flow of idle, excess, and surplus materials by freeing them from WPB restrictions, except for the very few critical materials, such as tin and other items remaining on Lists A and B which covers domestic and export specify sales restrictions.

The restrictions on these materials

ALL STEEL INDUSTRIAL FLUORESCENT FIXTURES



For

ESSENTIAL PLANT LIGHTING

OAMCO All-Steel Heavy Duty Industrials incorporate many desirable features for installations in plants where maximum lighting efficiency and minimum service delays are essential. Reflectors that can be removed for cleaning without disturbing wiring or using tools and starter replacements without lamp removal are but two of the features that speed up servicing.

Reflectors are furnished with either synthetic or porcelain enamel finish and have a reflection factor of more than 80%. Exterior finish is gray.

Enclosed Ballast type are furnished in double 40, triple 40 and double 100 watt sizes and the Exposed ballast type in double 40 only.

Write or wire today for our 1945 catalogs, Fluorescent #106 and Incandescent #104-A.

RIGHT LIGHT SINCE 1902

OVERBAGH & AYRES MFG. CO.

MEMBER OF THE R.L.M. STANDARDS INSTITUTE

411 SOUTH CLINTON STREET • CHICAGO



Eliminate Dangerous Make-Shift Cable Repairs With

MINES CABLE VULCANIZER KIT!

Make-shift repairs in rubber-covered portable electric cable are a constant cause of trouble, expense, and danger, often causing a portion of the cable to be sent to the scrap pile. Such a dangerous repair can be eliminated through the use of the Mines Portable Cable Vulcanizer Kit.



Safe cable repair made with Mines Kit

Typical ordinary taped splice after a short period of use

Thousands of Mines Kits have been in use by all branches of the Armed Forces where trouble-free cable repairs were a necessity and had to be made quickly. A repair made with the Mines Kit is flexible, little more in diameter than the cable itself, and many be wound on a reel.

The Portable Kit contains all necessary supplies and tools. Molds are available for various cable types. Sizes up to 1⅜ inch diameter may be accommodated in the VDIR-213.

Write for bulletin RV-104K.

MINES EQUIPMENT COMPANY

4231 Clayton Avenue
St. Louis 10, Missouri

must still be observed, WPB asserted.

Special sales, according to WPB designation, are sales by persons who acquired or made the materials for use and not for sale or resale. In addition, all sales of surpluses by Government agencies are special sales.

Under the latest amendment to Priorities Regulation 13, effective October 1, there are a few deletions from the lists.

The items still restricted in domestic special sales are:

Antimony, pig tin, uranium, manila and agave cordage fibres and rope, textiles materials obtained under Conservation Order M-328-B, orders in the M-388 series, and natural rubber. All of these now require a specific authorization from WPB, except the materials obtained under Conservation Order M-328-B and orders in the M-388 series, which the holder may sell only on orders rated with the new "CC" rating or higher.

Direction 3 relating to sales of surplus property to Government agencies and State or local governments has been amended to correspond to the change in the regulation, so that WPB preference ratings no longer have any effect on disposals of surplus property.

DATES AHEAD

New York Chapter, IAEI—Electric & Gas Association of New York, 480 Lexington Ave., New York, N. Y., November 5.
Tacoma Division, Puget Sound Chapter, IAEI—Loughlen's Cafe, 917 Pacific Ave., Tacoma, Wash., November 8.
Rocky Mountain Chapter, IAEI—Room 385, City and County Building, Denver, Colo., November 13.
North and South Carolina Chapter, NECA—Charlotte, N. C., December 5-6.
Rocky Mountain Chapter, IAEI—Room 385, City and County Building, Denver, Colo., December 11.

MANUFACTURERS NEWS

G-E APPOINTMENTS

L. F. Kummel has been appointed sales manager, underfloor distribution systems, of the conduit products division of General Electric Company. Mr. Kummel was formerly district manager of the construction materials division in Cleveland.

Ralph C. Dean has been appointed sales manager of the conduit products division of General Electric's Appliance & Merchandise Department.

W. S. Hay has been named sales manager of the York Wire & Cable Division of G-E's Appliance &

BETTER LIGHTING IS A NATURAL RESULT WITH **MULTI** *Reflectors*



• All time favorites . . . that's the way contractors feel about the MULTI line. They have good reason too—MULTI is complete—they can get the proper unit for any type of installation—maintenance is simple—no after worries. Here is your modern, flexible line of Reflectors that gives long-time service and better lighting.

• Send for Complete Catalog

MULTI
ELECTRICAL MANUFACTURING CO.
1840 W. 14th ST., CHICAGO, ILL.

Test-O-Lite
TESTS ANY VOLTAGE...
100 to 550 Volts, A.C. or D.C.
—Safely, Swiftly, Surely



THE NEON GLOW LOCATES TROUBLE INSTANTLY

Indicates hot or grounded wires. Tells AC from DC. Far superior to ordinary clumsy test bulb. Indispensable in shop or home. The only pocket-size tester with PATENTED SAFETY FEATURE. Lifetime guarantee. List $1.50. Purchase thru regular electrical dealers. Pat. No. 1,778,883.



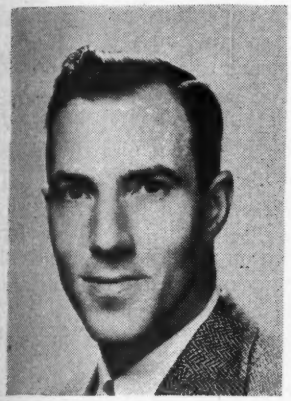
For Quick Soldering

A small quantity applied to the joints to be soldered will, WHEN HEATED, flow and unite the parts the same as wire and bar solder No flux or soldering iron required. (Priority A-7 or better) 25c tubes; 1, 5, 10 and 25-lb. cans.

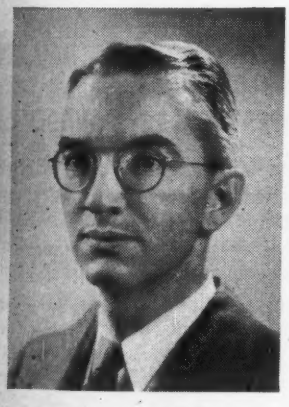
L. S. BRACH Mfg. Corp.
55-63 Dickerson St. Newark, N. J.



L. F. KUMMEL



R. C. DEAN



W. S. HAY

chandise Department. He was formerly commercial engineer for the York division.

C. P. Dunning has been appointed local manager in New York for the Appliance and Merchandise Department.

GRAYBAR APPOINTMENTS

Harold P. Litchfield has been appointed assistant general sales manager of the Graybar Electric Company. He will supervise all sales contracts with the General Electric Company including its Lamp Division and have charge

ACCEPTANCE!



In six short months the new ROYAL-NOARK Non-Renewable Fuses have earned acceptance by electrical men everywhere. For 5-way-better performance specify ROYAL!



ROYAL

Write for descriptive catalog

WIRE • CORD SETS • CARTRIDGE and PLUG FUSES • FUSTATS • TROUBLE LIGHTS • CHRISTMAS LIGHTING SETS

ROYAL ELECTRIC CO., Inc., PAWTUCKET, R. I.

the BETTER BUYERS are SPECIFIERS of SPEER CARBON BRUSHES



Men who know their brushes know the top-notch quality of those made by SPEER. Nearly fifty successful years of service in every type of commutating motor and generator have built acceptance for Speer brushes everywhere brushes are used.

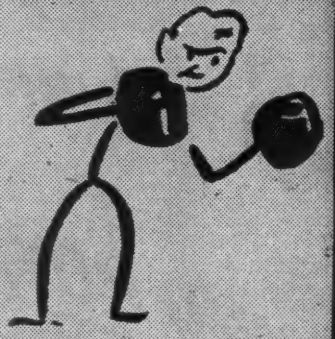
SPEER brushes are easy-to-handle, easy-to-sell. When you stock up on SPEER brushes you can stack up profits, from users of every kind of commutating equipment—for there are SPEER brushes for each of your customers' machines. Every SPEER brush is *right* for its job. Write for details.

SPEER
CARBON COMPANY
ST. MARYS, PA.

CHICAGO • CLEVELAND • DETROIT
MILWAUKEE • NEW YORK • PITTSBURGH

264

THE IWI MAN WITH A WISE PLAN



Manning 300 All Rag Paper has stamina and a high dielectric strength. For superior insulating quality, use Manning Products.

uses

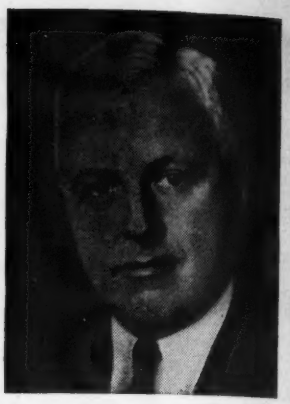
MANNING PAPER

it's tough!



INSULATION AND WIRES
IWI
SERVICE

INSULATION & WIRES, INC.
2127 PINE STREET • ST. LOUIS, MO.



H. P. LITCHFIELD

of Graybar sales in lighting, lamps, power apparatus, marine and signaling, reporting to G. F. Hessler, vice president.

E. F. Murphy becomes general commercial sales manager, taking over Mr. Litchfield's duties on national accounts reporting to Mr. Hessler. He will make his headquarters in the executive offices and continue the activities he formerly carried on as Eastern commercial sales manager in addition to his new national accounts assignment.

L. J. Olivier has been appointed merchandising manager for Graybar in New Orleans. For the past 18 years he has been associated with the Louisiana Power and Light Company in New Orleans.

WICKSTRUM NAMED MIDWEST SALES MANAGER

The Lighting Division of Sylvania Electric Products Inc. has announced the appointment of B. K. Wickstrum as Midwestern sales manager with headquarters at 135 South LaSalle St., Chicago. Since 1943 he has been Syl-



B. K. WICKSTRUM

vania's Pacific Coast Sales Manager directing selling, servicing and engineering activities in the Northwestern and California territorial divisions of the company.

AMERICAN STEEL & WIRE APPOINTMENTS

C. N. Schmidt has been appointed advertising manager of the American Steel & Wire Co., subsidiary of U. S. Steel Corp. Wilmer H. Cordes has been named manager of sales research, development and promotion.

C. H. Schiller has been appointed manager of market research and sales analysis. H. M. Ridlon has been named assistant manager and A. W. Ruttkamp, formerly manager, has been assigned special duties for the general manager of sales.

N. J. CONRAD REACQUIRES S & C

Nicholas J. Conrad has resumed control of Schweitzer & Conrad, Inc. He has acquired the entire outstanding common stock from Cutler-Hammer, Inc. and also has acquired from other interests all of the preferred stock which he did not formerly own.

Under the new program, Mr. Conrad, who was a co-founder of the company in 1910, and who sold his chief interest in 1930, again will resume active management as president. His son, John R. Conrad, will become vice president.

AMERICAN CENTRAL APPOINTMENTS

The appointment of Clyde T. Graham as district manager in Dayton, Ohio, for the American Central Manufacturing Corporation has been announced.

W. Graham Riley has been named district manager in Chicago and Gene Henry has been named district manager in Atlanta, Ga.

The Stanley & Patterson Division of the Faraday Electric Corporation has appointed Albert A. Schuhler as branch manager of their New York City Office at 101 Park Avenue.

Mr. Schuhler has wide experience specializing in signaling and communication systems and has been associated with Holtzer-Cabot Electric Co., Stanley & Patterson Inc., & Schwarze Electric Co. which firms now comprise this consolidation.

During the war period he was associated with the Selenium Rectifier Division of the Federal Telephone & Radio Corporation and was responsible for signaling, communication and allied applications and collaborated with the government and its cooperating research development laboratories.



Here's Why You'll Like to Use

G-E WHITE RIGID CONDUIT

G-E White Rigid Conduit can be installed quickly and easily. The high quality of this hot-dipped galvanized conduit precludes trouble after installation.

INSTALLATION FEATURES

Some of the features of G-E White which make it easy to use include:

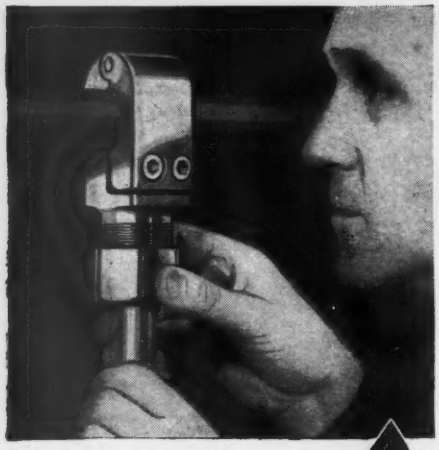
1. Accurate threads shielded with good thread protectors
2. Easy to cut on the job
3. Easy to thread on the job
4. Wires can be pulled easily. Interior of conduit is wiped by close-fitting asbestos tassel while zinc is in molten condition. Glyptal coating is added by slow dipping which provides a smooth, uniform interior.
5. Every length of G-E White is straightened after galvanizing to provide best appearance when installed.

QUALITY FEATURES

This easy-to-install conduit gives wiring permanent protection. It is heavily coated with zinc inside and outside by immersion in molten zinc—the hot-dipped galvanizing method. In addition, G-E White has a coating of baked Glyptal inside and out. G-E White goes through four different inspections during manufacture—more than any other conduit. Uniformity and freedom from defects are assured. (Another G-E conduit, G-E Black, is also available. This conduit is enamel-coated and is recommended for interior use or for use where conduit is exposed to chemical corrosion.)

For further information see the nearest G-E Merchandise Distributor or write to Section C1151-8, Appliance and Merchandise Department, General Electric Company, Bridgeport, Connecticut.

GENERAL ELECTRIC



It's Easy to pick the right CABLE TAP— **from the *Complete* line**

You'll find the widest variety of parallel and 90° taps, combinations, and gutter taps — in a range of sizes up to 1,000,000 cm. Insulating Bakelite covers can be furnished for all types.

Single 90° Tap from main conductor.

Combination Tap, one branch parallel to main, one at 90°.

2-Way Gutter Tap.

Bakelite Covers can be furnished for all types of Penn-Union cable taps.

3-Way; continuous main and two separate branches.

Also a complete line of Service Connectors, Terminals, Tees, Straight and Parallel Connectors, Grounding Connectors, etc. — every good type of conductor fitting. And every one is accurately made, thoroughly tested — *dependable.*

PENN-UNION
ELECTRIC CORPORATION
ERIE, PA.

PENN-UNION
Conductor Fittings

Westinghouse Electric Corporation has named J. E. Grannis as sales development manager for the Electric Appliance Division, Pacific Coast District. Mr. Grannis will make his headquarters at San Francisco.

•

J. M. Livingston, with offices at 30 North LaSalle Street, Chicago, Ill. has been appointed sales engineer for the **Standard Transformer Company** of Warren, Ohio. He will cover the northern sections of the states of Illinois and Indiana. Mr. Livingston was formerly sales manager for the Schweitzer Conrad Company with headquarters in Chicago.

•

Allis-Chalmers Manufacturing Co. of Milwaukee has appointed Arthur R. Tofte as manager of the advertising and public relations department. He succeeds George J. Callos, who resigned to become vice president and account executive for Klau-Van Pieterson-Dunlap Associates, Inc., Milwaukee advertising agency.

•

Trumbull Electric Manufacturing Company of Plainville, Conn. has announced the appointment of Lt. Col. A. A. Watson as manager of the Norwood plant, located near Cincinnati, Ohio.

•

Russell Electric Co. of Chicago has appointed A. O. Seehafer general sales manager. He has been with Russell Electric since 1944, and was instrumental in handling many of their war contracts.

•

Bright Light Reflector Company has given up its Brooklyn, N. Y. factory and is transferring all manufacturing to its recently acquired Bridgeport, Conn. plant. The new factory occupies a four and one half acre site, and has approximately 100,000 square feet of floor space.

•

R. C. Krueger, for 15 years in charge of advertising, merchandising and promotional activities for **Kellogg Switchboard and Supply Co.**, Chicago, has been appointed manager of the company's new Koiled Kord Division.



PAINE 445

CONDUIT CLAMP

For Hanging Conduit, Pipe and Cable. Holds Them away from Wall Surface.

The special Offset feature speeds wiring installation and simplifies maintenance. Clamps are available in rigid or thin wall sizes with the correct size bolt and nut inserted. All are rust resistant.

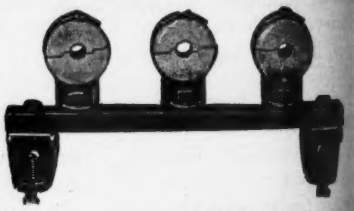
Ask your Supplier or write for Catalog.

THE PAINE CO.
2961 Carroll Ave. Chicago 12, Ill.
Offices in Principal Cities

PAINE
FASTENING and HANGING DEVICES

NEW!

Non-Inductive Conductor Racks



Racks available for any number of cables — cable sizes 5/16" to 2⅜".

● Available in types for any number of cables, the M & W Type S-L Conductor Rack is designed so that cables are only partially surrounded by metal. This prevents induced current—permits the rack to be used for A.C. or D.C. systems. Simple design makes for quick, easy mounting of cables.

Write today for Bulletin C-5-51 . . . contains full information on M & W Non-inductive Cable and Conductor Racks.

M. & W.
ELECTRIC MFG. CO.
EAST PALESTINE OHIO

INFRA-RED RAY

DRYING • BAKING • DEHYDRATING



Radiant Energy, The Modern Method Cuts Drying Cost, Saves Time, Uses Minimum Space, Produces Uniform Results with

NALCO CARBON FILAMENT Lamps



Use Nalco Dritherm Lamps for efficient results . . . available in Inside-Silvered (self-reflecting) or clear glass types.

Learn all of the advantages of the Infra - Red Process — Write for your free copy of "Drying Problems Made Easy" today.

← Illustrated a five-light portable adjustable Nalco Unit with gold-plated Reflectors.

NORTH AMERICAN ELECTRIC LAMP CO.

1044 Tyler St. St. Louis 6, Missouri



IMPORTED SWISS 5-RANGE, CENTRIFUGAL TYPE HAND TACHOMETERS

CATLG. NO. 303	CATLG. NO. 346
30—120 RPM	120—480 RPM
100—400 RPM	400—1600 RPM
300—1200 RPM	1200—4800 RPM
1000—4000 RPM	4000—16,000 RPM
3000—12,000 RPM	12,000—48,000 RPM

FOR DETAILS WRITE FOR BULLETIN NO. 750. NO PRIORITY REQUIRED

HERMAN H. STICHT CO., INC.

27 PARK PLACE NEW YORK, N Y

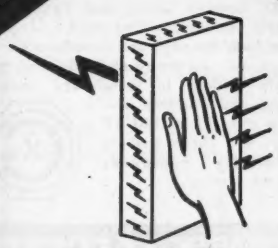
It's Naturally Safer..

WIRE WITH

PORCELAIN



Porcelain Insulates and Protects.

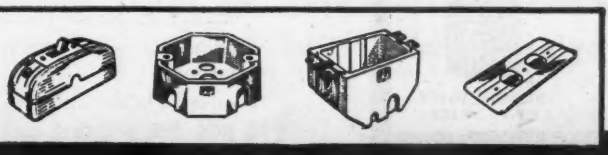


No dangerous stray currents.

...Means Greater Goodwill and PROFIT *for You!*

Because the PORCELAIN way is based on using *insulating—not conducting*—materials for enclosures and supports . . . it's *naturally* safer! Porcelain protects and insulates—refuses to transmit or conduct dangerous stray currents.

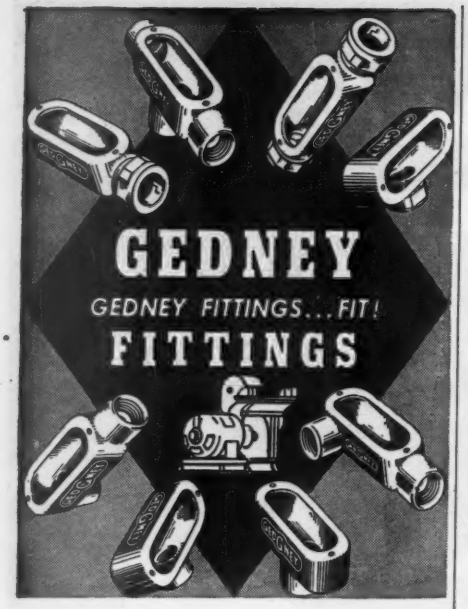
Modern PORCELAIN Protected Wiring also offers time-proved advantages in permanence—economy—and ability to carry a bigger load. Only the non-metallic way has a record of nearly fifty years of efficient, dependable service. Ask your friendly Electrical Inspector about the safety and long-life features of knob-and-tube wiring. Write for wiring catalog.



PORCELAIN PRODUCTS, Inc.

FINDLAY, OHIO

Wire Today for Tomorrow's Load



GEDNEY Conduit Bodies and Fittings are available for every wiring need. Complete lines of both threaded and threadless fittings are included. All are carefully finished, protectively packed in metal-edge cartons, clearly marked for time saving on the job. GEDNEY fittings are Underwriters Laboratories approved. Write for catalog.

GEDNEY ELECTRIC COMPANY
RKO BLDG., RADIO CITY, NEW YORK, N. Y.

SOLAR
Electrical Products



Quotation on request

SOLAR ELECTRIC CORPORATION
WARREN, PENNSYLVANIA

How Much Will It Cost—Part II

[FROM PAGE 55]

to accommodate changing material costs and labor rates, or variation in markups.

The adjusted price column is included in the tables to enable the estimator to adapt the units to his own locality. These tables were primarily established for contractors in the Chicago area and include 14½ percent of the base labor costs to cover "Trustees" (employee benefit insurances—a labor-management program in Chicago), liability and other insurance costs. In some localities, the insurances may amount to only 8½ percent—or 6 percent less than the figure used in establishing the above tables. A markup of 15 and 10 percent would raise the amount from 6 to 7.6 percent. To secure an adjusted selling unit, 7.6 percent of the base labor would be deducted from the unit in the tables.

For example: The estimated selling unit for a 400-amp. service with three 500MCM. cables in 3-inch conduit is $422, with a base labor of $97. The adjustment unit would be $422 less (7.6 percent of $97) = $414.63.

In adjusting units, it must be kept in mind that the 20 percent added to labor is a *direct job cost* covering insurance and other expense items identified with the particular work. Subtracting the 14½ percent (cost of insurance) leaves 5½ percent for other expenses—a nominal allowance when one considers that it covers the cost of construction engineering, tools, cartage (tools), and other relevant items.

Unit costs and selling prices per circuit-foot for conduit and wire are listed in Table II, Sheets 1 through 4. These tables were developed along the same lines as that for Services. Estimates of the conventional type were made for a typical 100-ft. run of conduit (See Fig. 3) including the following items:

- 105 ft. of conduit (5 ft. allowed for shrinkage)
- 115 ft. of wire per leg (10 ft. for ends, 5 ft. for shrinkage)
- 2 elbows (1-in. conduit and larger)
- 1 offset (labor only)
- 1 pull box (large enough for straight-through pull)
- Conduit fastenings (inserts for concrete, etc.)

By including allowances for shrinkage, pull boxes, elbows, offsets, etc., the final unit is sufficient to cover all expenses encountered in the ordinary wiring installation.

WHERE TO BUY

Equipment, Materials and Supplies for Electrical Construction — Maintenance — Repairs

TORK

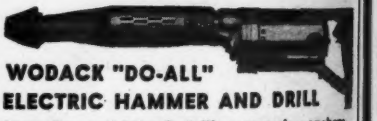


TURN ANYTHING ELECTRICAL ON & OFF REGULARLY

The TORK CLOCK CO., Inc.
MOUNT VERNON, NEW YORK

ALLEN FLUX
for SODERING
Silver Soldering
WELDING
L. B. ALLEN CO., INC.
6715 Bryn Mawr Chicago, 31, Ill.

DRILL CONCRETE THE EASY WAY



WODACK "DO-ALL"
ELECTRIC HAMMER AND DRILL

Saves time and labor installing expansion anchors. Two motions—reciprocal for hammer drilling—rotary for twist drilling. Drills masonry to 1⅝", dia., metal ⅝". Easy to maintain. Universal motor, runs direct from lamp socket. Weighs 15 lbs. Star drills in 17 diameters. Also chisels, bull points, etc. Ask for bulletin.

Wodack Electric Tool Corporation
4628 W. Huron St. Chicago 44, Ill.
Telephone AUstin 9866

Burned Out or Broken Electric Heating Elements



repaired with NICHROCITE PASTE. Simply overlap ends, apply paste, turn on current. Used by utility companies, etc. Family size, $1.00. 4 oz. size $2.50. Satisfaction guaranteed.
ARMSTRONG Mfg. Co., Box 861F, Minneapolis, Minn.

Make it a HABIT . . . to check this page—EACH ISSUE

THIS CONTACTS SECTION supplements other advertising in this issue with these additional announcements of products and services essential to efficient and economical operation in the field of ELECTRICAL CONTRACTING

How to select • operate • maintain the *right* controllers for your electric motor power

Here is your controller guide for selecting and using the control apparatus that will best harness your electric motor power to your load requirements. This book takes the guess-work out of control purchase and presents the operator with all the facts on controller operation and design. Hundreds of diagrams, illustrations, curve charts and tables, together with a simple, direct text, instruct operating men, engineers, purchasers of control, on each detail of proper selection, operation and maintenance.

Just Published!

CONTROLLERS FOR ELECTRIC MOTORS



By Henry Duvall James
Consulting Engineer, Pittsburgh, Pa.
and Lewis Edwin Markle
Design Engineer

324 pages, 6½ x 9¾, 276 figures, 6 tables, $3.50

This book brings you up to date on the latest control apparatus—new uses of the electron tube, magnetic contactors, time-limit method of acceleration, development of plugging control, and of the Regulex, Ampledyne and Rotorol, and new types of time-delay overload relays. Here is analysis of popular commercial types, and most successful methods of accelerating motors, speed control, mechanical and dynamic braking, regeneration, and voltage control for d-c motors, with special sections on protective devices, national codes, installation and maintenance, and future control developments.

Detailed information on:

Functions, types, advantages and limitations of magnetic contractors
De-ion principle of arc rupturing
Use of two power tubes to give more uniform d-c power
Time-limit methods of accelerating motors
Motor-generator control of motor voltage
New types of time-delay overload relays

• There is a section on how to read controller diagrams, and a section devoted to future control developments describes new developments from World War II, electron-tube control, variable frequency, hydraulic gear, the use of telephone devices and practice, radio signals, etc.

See it 10 days • Send this coupon

McGRAW-HILL EXAMINATION COUPON

McGraw-Hill Book Co., 330 W. 42nd St., N. Y. C. 18

Send me James and Markle's Controllers for Electric Motors for 10 days' examination on approval. In 10 days I will send $3.50, plus few cents postage, or return book postpaid. (Postage paid on cash orders.)

Name .....

Address .....

City and State .....

Company .....

Position .....EC 11-45

A Message To Contractors Who Are Trying To Go It Alone

Sherman

SOLDERLESS LUGS

SOLDERING LUGS

WIRE AND CABLE CONNECTORS

FIXTURE CONNECTORS

GROUND CLAMPS AND FITTINGS

ELECTRICAL TERMINALS

WEDGE GRIP CONNECTORS

A long time ago, somebody said, "We'd better hang together or we'll all hang separately." In the electrical trade, things aren't much different today. Powerful interests are opposing you, Mr. Contractor. The one way you can fight your own battle successfully is through *organization.*

The unions have shown what can be done through organization. They are going after what they want, and you can do the same, by joining efforts with your fellow contractors, in your local, state, and national associations.

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These conduit and wire units can be used for (1) preliminary field estimating and (2) checking feeder sheets on conventional estimates. Examples of these applications are shown in Fig. 4. In ordinary estimating, the feeder sheet would show only the base costs without the addition of operating costs and return. For checking such a sheet, only the base costs of the material and labor would be used. Material cost is made up of the two items conduit and wire—units for which are found in Columns A and B of the cost sheets in Table II. Column C of this table presents the base labor cost. The feeder cost sheet being checked should, of course, include elbows, conduit fastenings and other items incidental to installation of the conduit and wire involved.

In the examples indicated in Fig. 4, only one feeder of each size is listed. Where several feeders of the same size occur, each feeder could be listed separately or the total length of all of identical size could be used in the quantity column.

Use of Tables

The conduit and wire tables listed are for industrial installations containing 12-ft. ceilings and clear working spaces. When other job conditions are encountered adjustments must be made for:

1. Ceiling height
2. Occupied areas
3. Multi-story buildings
4. Cutting floors and walls
5. The labor market (availability of good mechanics)

Before using tables prepared by others, it is a good idea to make a few estimates for "spot checking." By doing this, the estimator can better understand the units and more readily make adjustments for varying conditions. It is well to check against specific jobs. Experience shows that one is more apt to overlook many pertinent cost items when using hypothetical cases.

The accompanying unit selling cost tables are a tremendous time saver when making quick preliminary estimates. For the sake of practice, take the service and feeder estimate of an old job, rework it using these tables and "see for yourself."

Future articles in this series will consider unit cost tables for other phases of an electrical installation and will explain why the above "Conduit and Wire" units *do not contain* cable connection and conduit terminal labor cost items.

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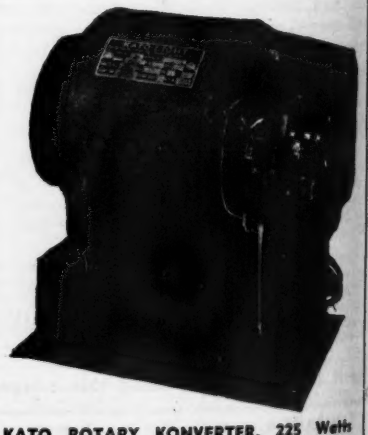
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Of Electrical Contracting, published Monthly at Albany, New York, for October 1, 1945.

State of New York } ss.
County of New York }

Before me, a Notary Public in and for the State and county aforesaid, personally appeared J. A. Gerardi, who, having been duly sworn according to law, deposes and says that he is the Secretary of the McGraw-Hill Publishing Company, Inc., publishers of Electrical Contracting and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, as amended by the Act of March 3, 1933, embodied in section 537, Postal Laws and Regulations, printed on the reverse of this form, to wit:

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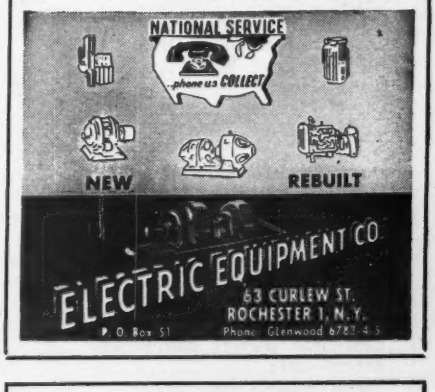
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Advertising In This Issue

*Adam Electric Co., Frank 100
Advance Transformer Co..... 224
*Aerovox Corporation 228
All-Bright Electric Co..... 190
*Allen-Bradley Co. 177, 178
*Allen Co., Inc., L. B. 238
*Allis-Chalmers Mfg. Co.....2, 5, 6, 7
*All-Steel-Equip Co. 20
Aluminum Co. of America..... 33
*American Steel & Wire Co. 34, 35
*American Transformer Co. 9
*Anaconda Wire & Cable Co. 44
*Appleton Electric Co. 92
Armstrong Mfg. Co..... 238
Arrow-Hart & Hegeman Elec. Co... 196
*Associated Research, Inc. 226
*Austin Co., M. B. 207
*Auth Electrical Specialty Co., Inc. 229
Automatic Elec. & Mfg. Co..... 240

*Baldor Electric Co. 175
Bell Sound Systems, Inc..... 218
*Benjamin Electric Mfg. Co. 85
Blackhawk Mfg. Co..... 230
Brach Mfg. Corp., L. S..... 232
*Briegel Method Tool Co. 174
Briggs Clarifier Co..... 241
*Bright Light Reflector Co. 186
Bryant Electric Co..... 90
*BullDog Electric Products Co. ... 94
*Bussmann Mfg. Co. 86, 87

Cannon Elec'l Dev. Co..... 215
Century Electric Co..... 161
Certified Ballast Mfrs..... 153
Coffing Hoist Co..... 117
Columbia Metal Box Co..... 112
Cordley & Hayes..... 113
Coyne Electrical School..... 208
Crescent Ins. Wire & Cable Co..... 173
*Crocker-Wheeler Div., Joshua Hendy Iron Works..... 138
Crouse-Hinds Co. 27
Curtis Lighting, Inc..... 89
Cutler-Hammer, Inc. 128

Davis Transformer Co..... 144
*DayBrite Lighting, Inc..... 91
Dolph Co., John C..... 140

Economy Fuse & Mfg. Co..... 108
Edwards & Co. 205
*Efficiency Elec. & Mfg. Co..... 172
Electric Equipment Co..... 241
Electrical Buyers Reference..... 36
Electro Mfg. Co.....78, 79
Electromode Corp. 221
Employment 241

*Fairbanks, Morse & Co..... 169
Federal Electric Products Co..... 171
*Feedrail Corp. 219
Fostoria Pressed Steel Corp....142, 143
Frankel Connector Co..... 222
*Fullman Mfg. Co..... 204

Garden City Plating & Mfg. Co.... 226
*Gedney Electric Co..... 238
General Cable Corp....30, 31, 110, 111
*General Electric Co. (Bridgeport) Back Cover, 102, 132, 211, 223, 235
*General Electric Co. (Nela Park). 151
*General Electric Co. (Schenectady) Inside Front Cover, 10, 11, 13, 15 17, 18, 19, 206
General Luminescent Corp..... 214
Goodrich Chemical Co., B. F..... 32
Goodrich Electric Co. 217
*Graybar Electric Co.....46, 81, 123, 124
*Greenlee Tool Co..... 116
Guth Co., Edwin F..... 220

Hall Lamp Co., C. M..... 149
*Hazard Ins. Wire Works Div..... 23
Holdenline Company 183
Hubbell, Inc. Harvey..... 84
*Hullhorst Micro Tool Co. (Div. of Toledo Standard Comm. Co. 218

*Ideal Commutator Dresser Co..... 42
*Ilg Electric Vent. Co..... 83
*Illinois Electric Porcelain Co...14, 201
*Ilsco Copper Tube & Products Co. 230
Independent Pneumatic Tool Co... 88
*Insulation & Wires, Inc....74, 224, 234
*Irvington Varnish & Ins. Co..... 21

Jacques Power Saw Co..... 209
*Jefferson Electric Co..... 96
Jenkins Bros. 76
*Johns-Manville 26
*Johnson Bronze Co..... 175
Justrite Mfg. Co..... 122

*Kato Engineering Co..... 240
*Killark Elec. Mfg. Co..... 156
Kinney Elec. Mfg. Co..... 208
*Klein & Sons, Mathias..... 179
Kondu Corp. 240

*Leader Elec. Mfg. Corp..... 101
*Lighting Products, Inc..... 203

Master Vibrator Co..... 174
*McGill Mfg. Co. 148
McGraw-Hill Book Co..... 239
Mell-O-Chime and Signal Corp.... 214
*Mercoid Corp. 120
*Metropolitan Device Corp..... 1
Miller Co. 24
Mines Equipment Co..... 232
Mitchell Mfg. Co..... 95
Moe-Bridges Corp. 192
Monarch Fuse Co..... 202
*Mossman, Inc., Donald P..... 106
Mudon, T. J..... 228
Multi Electric Mfg. Co. 232
*M & W Electric Mfg. Co..... 236

National Elec. Products Corp..... 121
*North American Electric Lamp Co. 237

*Okonite Co. 23
*Onan & Sons, D. W..... 216
Operadio Mfg. Co..... 182
Overbagh & Ayres Mfg. Co..... 231
*Owens Corning Fiberglas Corp..... 22
*O. Z. Electrical Mfg. Co..... 227

*Paine Co., The..... 236
Paragon Electric Co. 150
*Paranite Wire & Cable Corp..... 72
Pass & Seymour, Inc. 200
*Pelham Elec. Mfg. Corp. 184
*Penn Union Elec. Corp..... 236
Plastic Wire & Cable Corp..... 4
Porcelain Group 201
*Porcelain Products, Inc.....201. 237
Pryne & Co..... 225
Pyle-National Co., The..... 176

*Quadrangle Mfg. Co. 152

Radio Corp. of America.....126, 127
Reading Electric Co., Inc..... 216
*Reliance Automatic Lighting, Inc. 222
Republic Steel Corp.....98, 99
*Revere Elec. Mfg. Co..... 97
*Ridge Tool Co..... 163
*RLM Standards Inst., Inc..... 146
Robertson Co., H. H..... 29
*Roebling's Sons Co., John S. 118, 166, 167
*Roll-a-Reel 212
Royal Electric Co..... 233
*Rusgreen Mfg. Co..... 230
*Russell & Stoll Co..... 213

*Sangamo Electric Co..... 198
Searchlight Section 241
*Sherman Mfg. Co., H. B..... 239
Simplex Wire & Cable Co..... 165
*Solar Electric Corp. 238
*Sorgel Electric Co. 210
*Spang-Chalfant 25
*Specialty Porcelain Works..... 201
*Speer Carbon Co..... 234
*Spero Electric Corp..... 185
Square D Company Inside Back Cover, 119
Star Electric Motor Co..... 141
Steel & Tubes Division.....98, 99
*Sticht Co., Herman H..... 237
Stockwell Transformer Corp. 144
Surprenant Elec'l Ins. Co..... 107
*Superior Carbon Prod. Co., Inc.... 172
*Sylvania Electric Products, Inc.... 71

*Thermador Elec'l Mfg. Co..... 16
Thomas & Betts..... 82
*Toledo Pipe Threading Mach. Co. 8
*Toledo Standard Commutator Co... 218
*Tork Clock Co., Inc..... 238
Trico Fuse Mfg. Co..... 168
*Trumbull Electric Mfg. Co..... 104

*Unistrut Products Co..... 136
*United States Rubber Co.....130, 194
*United States Steel Corp.....34, 35
United States Treasury Dept..... 38
*Universal Clay Products Co..... 201
Universal Tool Company..... 241
Universal Wire & Cable Co..... 241

Wagner Electric Corp..... 165
Wakefield Brass Co., F. W..... 93
Walker Brothers, Inc..... 37
*Ward Leonard Electric Co..... 220
*Ware Brothers, Inc..... 176
*Webster Electric Co..... 115
*Westinghouse Electric Corp. (East Pittsburgh) 28, 134, 135, 145, 189
*Westinghouse Electric Corp. (Lamp Division) 154, 155
*Westinghouse Electric Corp. (Lighting Division) 39
*Westinghouse Electric Corp. (Pittsburgh) 188
*Weston Electrical Inst. Corp..... 109
*Wheeler Reflector Co..... 103
Where To Buy..... 238
Wiremold Company 12
Wodack Elec. Tool Corp..... 238

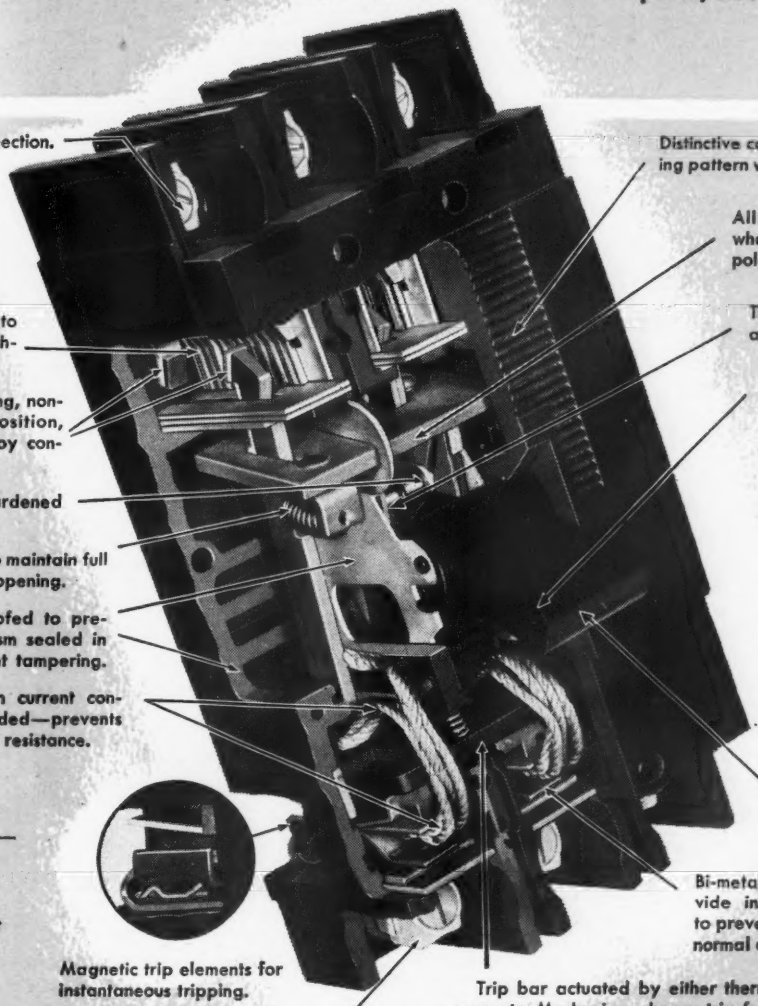
Youngstown Sheet & Tube Co..... 114

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